

# ANNALS of SURGERY

A Monthly Review of Surgical Science and Practice

Edited by LEWIS STEPHEN PILCHER, M.D., LL.D., of New York

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LEWIS STEPHEN PILCHER, M.D., LL.D.,  
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WITH THE ASSOCIATION OF  
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## CONGENITAL ANOMALIES OF THE DUODENUM WITH OBSTRUCTION AT THE DUODENOJEJUNAL ANGLE\*

BY E. STARR JUDD, M.D.

OF ROCHESTER, MINNESOTA

AND

ROBERT B. WHITE, M.D.

FELLOW IN SURGERY, THE MAYO FOUNDATION

PARTIAL or complete obstruction of the duodenum at the duodenojejunal angle, resulting from a congenital anomaly, is exceedingly rare. The condition is usually found at necropsy rather than at operation. A review of the records of The Mayo Clinic disclosed only two such cases. They are reported herewith.

REPORT OF CASES.—CASE I.—The patient, a man aged nineteen, the fourth child of healthy parents, born at full term, and breast fed, was perfectly well and developed normally until the age of two years, at which time attacks of abdominal pain appeared. The mother did not recall that the patient ever had had difficulty prior to the time of weaning. The pain occurred at intervals of from two to three weeks and was quite generalized, varying in intensity and beginning very soon after the ingestion of food. It was frequently associated with vomiting, which occurred from a few minutes to several hours after meals and in all instances afforded considerable relief. Often vomiting was induced, the patient finding that he derived immediate benefit by emptying his stomach. Certain foods did not seem to be a factor in precipitating the pain. Any food or even fluid caused the distress to persist during an attack and the patient had made it a practice to defer eating until all pain had subsided; otherwise the disturbance might last over a period of two or three days. May 24, 1927, the patient had the most severe attack since the onset of his illness. At that time the appendix was removed. The surgeon reported that the appendix was normal but was on the left side; he believed that all the abdominal viscera were congenitally on the left side, and that this anomaly was responsible for the attacks. One week after the operation the patient had an attack in all respects identical with the previous ones. He was unable to eat on account of the constant distress, with the result that he lost twenty-five pounds. Before coming to the clinic he was kept on a strict milk diet, with complete rest in bed for a period of a month without any benefit. In spite of his handicap the patient had been able to attend school and to do a moderate amount of light work during vacation.

The general examination was essentially negative except for marked emaciation. Röntgenograms of the stomach were negative. A pre-operative diagnosis of chronic intermittent intestinal obstruction (congenital anomaly) was made.

Exploration revealed chronic intestinal obstruction due to congenital malformation of the small intestine apparently at the duodenojejunal angle. The duodenum was dilated to about three times normal size; the distal half was completely covered with peritoneum

\* Submitted for publication August 6, 1928.

# JUDD AND WHITE

and possessed a short mesentery. There was a very firm band 7.5 cm. wide extending from the root of the mesentery across the duodenojejunal flexure and becoming continuous with the posterior leaf of the transverse mesocolon (Fig. 1). This band held the bowel fixed at this point and produced partial occlusion. The root of the mesentery,

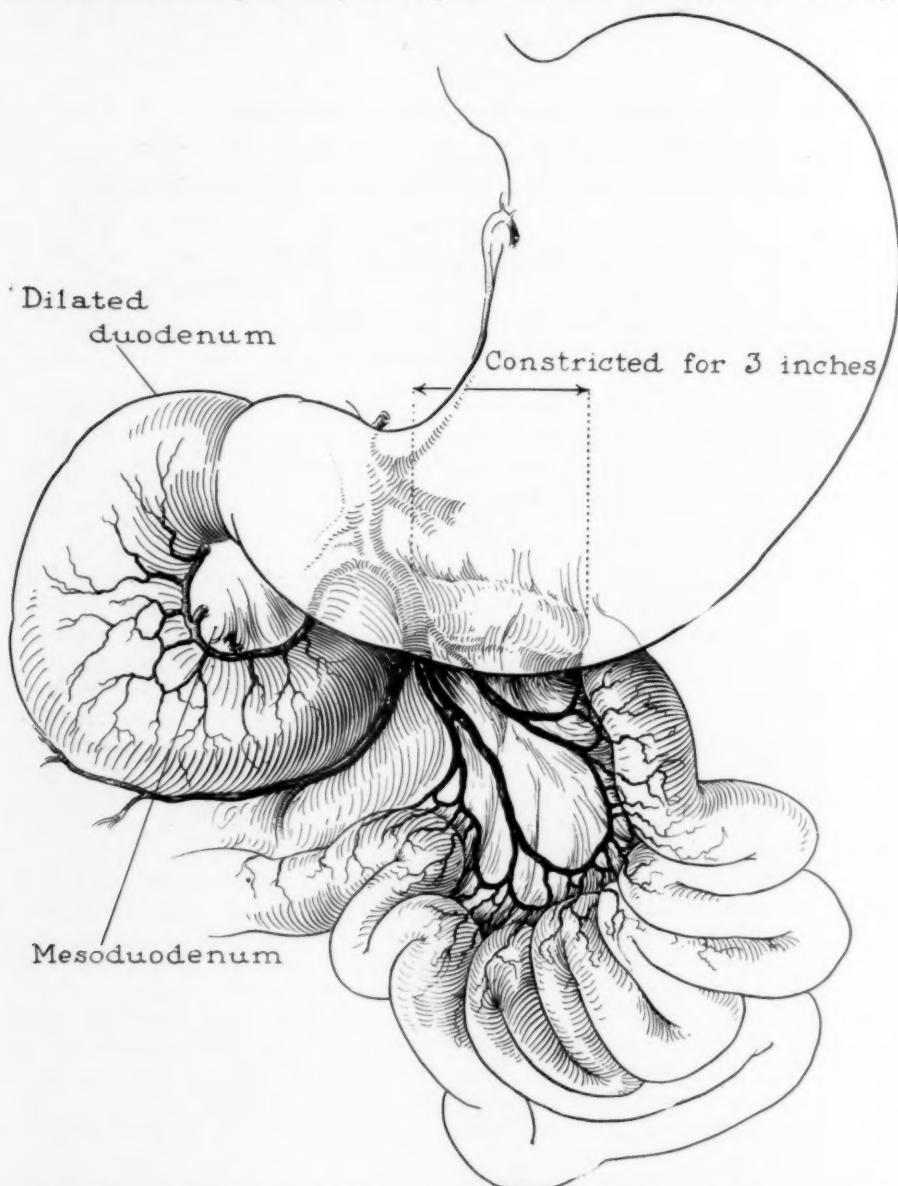


FIG. 1.—Dilated duodenum, due to obstruction produced by a peritoneal band 7.5 cm. wide extending from the root of the mesentery up across the duodenojejunal angle. Marked dilatation of the superior mesenteric veins may be noted.

instead of having its normal attachment to the posterior abdominal wall, along a line drawn from the left of the spine down to the right iliac fossa, seemed to be attached to a limited area anterior to the second lumbar vertebræ, being pedunculated as it were. The superior mesenteric veins were markedly dilated. Both the size and

## CONGENITAL ANOMALIES OF THE DUODENUM

position of the large intestine were normal, but the cecum and ascending colon possessed an abnormally long mesentery, thus allowing free motion of that part of the bowel. The peritoneal band was separated, freeing parts, but not releasing the obstruction entirely. Therefore a lateral anastomosis was made between the duodenum and the loop of the jejunum just below the point of obstruction (Fig. 2). The post-operative convalescence was uneventful. The patient has been free from symptoms for one year.

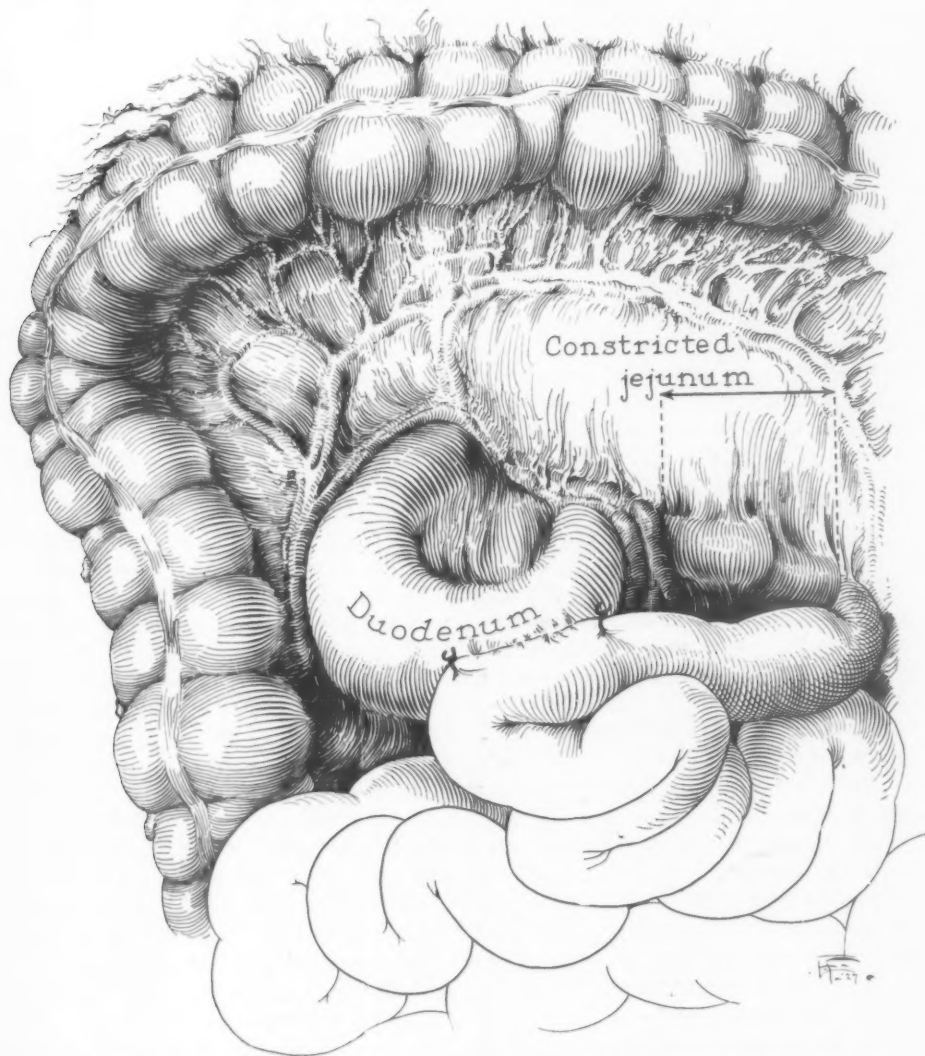


FIG. 2.—Anastomosis of the dilated duodenum to the jejunum just below the site of obstruction.

CASE II.—A woman, aged nineteen, came to the clinic, September 22, 1920, complaining of abdominal cramps of several years' duration. As far back as she could remember she had had attacks manifested by severe pains in the umbilical region, limited to an area 10 cm. in diameter, slow in onset, most marked after meals and lasting for from seven to ten days. Vomiting afforded some relief. Until two years before examination an average of two attacks had occurred yearly; they then became more frequent (every two months) and more severe, requiring morphine for relief. She finally

## JUDD AND WHITE

reached the stage where she was afraid to eat because of the possibility of precipitating an attack. The appendix had been removed in January, 1919, without benefit.

The general examination was essentially negative. Gastric analysis was negative. Röntgenograms of the stomach and colon were negative. The small bowel was empty at sixteen hours. Repeated examinations of the stools were negative for ova and parasites. The diagnosis was indeterminate, and exploration was advised.

The pelvic organs, kidneys and ureters were normal. The spleen was of normal size. There was no evidence of Meckel's diverticulum. The gall-bladder, ducts and pancreas were normal.

The duodenum was the only part of the small intestine which was distended and hypertrophied; it did not rotate up behind the stomach but came directly and obliquely downward and was compressed over the vertebræ by the weight of the mesentery of the small intestine. Instead of presenting on the left side of the vertebræ, the jejunum began in front and on the right side of the vertebræ. The peritoneal fold was divided in order to give a larger opening as the retroperitoneal portion of the duodenum became the jejunum. It was felt that the liberation of the constricting bands was sufficient to relieve the partial obstruction, although duodenojejunosomy might be necessary later. The immediate post-operative convalescence was uneventful, but the ultimate results were only fairly satisfactory.

**CASE LITERATURE.**—At a meeting of the Royal Academy of Medicine, in 1826, BARON exhibited the digestive canal of an infant that lived three days. The duodenum was much dilated and terminated in a cul-de-sac which became entirely obliterated where it joined the jejunum. The jejunum formed an extremely narrow canal of the size of the urethra ending in the cecum, and the large intestine scarcely presented the caliber of the duodenum.

CARLING reported a case of congenital stricture at the duodenojejunal angle in a married woman aged forty-seven. Frequent attacks of pain in the left hypochondriac and umbilical regions associated with copious vomiting had occurred six months previously. The pain came fifteen minutes after meals, and vomiting always afforded relief. At operation the duodenum was found to be greatly distended due to obstruction just below the jejunal flexure. Resection and lateral anastomosis were carried out. An uneventful convalescence followed. On examination of the specimen removed, a stricture was found which admitted only a very small probe. There was no evidence of malignancy or of an inflammatory process. The author concluded that the anomaly was purely congenital.

DENZER reported on the examination at necropsy of an infant twenty-six days old. The stomach and duodenum were dilated; the third portion of the bowel, instead of curving gradually upward, turned acutely to the left, creating a sharp duodenojejunal angle and producing obstruction. The jejunum just below this angulation emerged, clamped between the last few inches of the ileum dorsally, and the cecum and ascending colon ventrally. This was due to the fact that the cecum and ascending colon were held up to the root of the transverse mesocolon by an abnormal peritoneal attachment.

FREEMAN reported a case of a long U-shaped duodenum with a kink and a constriction at the duodenojejunal juncture. In this case the duodenum, instead of appearing in the abdominal cavity from beneath the transverse mesocolon to the left of the spine and being fixed retroperitoneally as it should, emerged to the right, its transverse and ascending portion possessing a peritoneal covering and mesentery of its own similar to the remainder of the small intestine. At the duodenojejunal angle, however, the bowel was attached to the root of the transverse mesocolon by a firm adhesion (duodenal fold of fetal life), the kink thus produced being intensified by the downward pull of the free duodenal loop.

MOORE described a specimen from a man aged forty in which there was a congenital stricture at the duodenojejunal angle, and three diverticula in the first three feet of the



## CONGENITAL ANOMALIES OF THE DUODENUM

small intestine. The narrowing at the jejunal flexure was caused by an internal ring of mucous membrane which would just admit the little finger.

SPRIGGS reported data on the examination at necropsy of an infant fourteen days old. The duodenum was dilated to the size of the stomach, due to congenital stenosis at the duodenojejunal angle. The stricture was slit-like and scarcely admitted a fine probe.

THOMAS reported on the examination at necropsy of an infant seven months old. The duodenum was dilated and occupied the greater part of the abdominal cavity, terminating on the left side of the spine in a blind extremity. There was no trace of any part of the small intestine and proximal half of the colon.

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## ATRESIA OF THE DUODENUM AND DUODENAL DIVERTICULA

BY JOSEPH KALDOR, M.D.

OF BROOKLYN, NEW YORK

FROM THE DEPARTMENT OF LABORATORIES OF THE UNITED ISRAEL ZION HOSPITAL

IN THE following paper two anomalies of the duodenum are presented together. Although they are apparently different in type, certain facts and their ontogenetical interpretation point to the possibility of a similar origin.

The first case, that of *atresia of the duodenum*, was found in a male child, born on March 31, 1928.

Condition at birth apparently normal, although underweight, five pounds, eight ounces. Baby lived five days and during this time the outstanding symptoms were continuous vomiting which developed soon after birth, jaundice, progressing emaciation, and no passage of meconium. Diagnosis of intestinal obstruction was made and operation resorted to.

Operative findings: Laparotomy, peritoneum covered with sanguinous exudate, stomach and duodenum enormously distended and latter ending in a blind pouch. Small intestine's upper end was also closed and its entity collapsed and under-developed. No possibility for any surgical procedure. Abdomen closed. The child died April 5. Weight at death four pounds, three ounces.

*Autopsy.*—Poorly developed and considerably emaciated male, white child. Skin and visible mucous membranes yellowish. In abdomen was found some fluid blood and clots, the

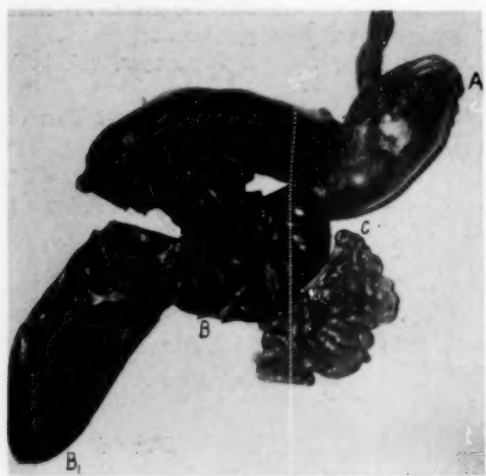


FIG. 1.—Atresia of Duodenum. A, Stomach; B, Duodenum; B<sub>1</sub>, closed end of Duodenum; C, closed upper end of Jejunum.

retroperitoneal connective tissue, omentum and mesentery infiltrated with blood. Liver, medium size; bile ducts, patent. Stomach, normal shape but somewhat distended, pylorus slightly contracted but patent. The duodenum was enormous, its volume exceeding that of the stomach several times, it was horse-shoe shaped and at the place where it should have continued into the jejunum it ended abruptly. The whole small intestine as well as the colon were completely collapsed. Other abdominal organs and mesenterium were normal.

*Pathological Diagnosis.*—Congenital malformation of the intestines, atresia of the duodenum, multiple peritoneal adhesions, intra-abdominal hæmorrhage, jaundice, uric acid infarctions of the kidneys.

The second case was that of a *duodenal diverticulum*, found in a white, male patient, age fifty-seven.

## ATRESIA OF THE DUODENUM AND DUODENAL DIVERTICULA

Patient admitted May 2, 1928. Died June 2, 1928. Emaciated and anæmic, complained of dizziness, weakness, and of pain in the upper abdomen during the last eight years. Intermittent hematuria for the last year. His stomach trouble he localized in the left upper quadrant following ingestion of meals, explaining that pain would come on soon after eating and last an hour, relieving itself without medication. Suffered with vomiting for a number of years but this condition subsided when the pain began eight years previously. Later, the pain was experienced all over the abdomen. Accompanying constipation. One sister and two brothers died of "constipation." Lost thirty pounds in the last two months. Main points in the physical examination were: Tenderness in the left upper quadrant and marked fulness in right upper half of the abdomen. In right hypochondrium, a firm and tender mass extending down to one finger's breadth below umbilicus and to the flank. Mass moved on respiration and had below a projection which corresponded to the kidney. Edge of the liver could not be made out because of its continuity to this mass. Liver extended to the left side across the epigastrium. Tenderness on pressure in right lumbar region. Few small inguinal glands.

*X-ray and Cystoscopic Diagnosis.*—Malignant growth of the right kidney.

*Blood Chemistry.*—Urea nitrogen, 20; creatinin, 1.9; glucose, 345; icteric index, 6.8; Wassermann, negative.

*Operation.*—Nephrectomy. During the course of this operation, because of the dense adhesions surrounding the tumorous kidney the enucleation was very trying and the peritoneum suffered a rent. Before inserting drains this rent was sutured and then the wound closed.

*Autopsy.*—Emaciated, elderly, white male. Acute purulent peritonitis, cedema and emphysema of the lungs, incipient cirrhosis of the liver, chronic swelling of the spleen with acute septic softening. Distention of the stomach and the duodenum. Duplex diverticulum of the duodenum, thrombosis of a branch of the pulmonary artery.

Microscopical examination of the kidney tumor proved to be a squamous-cell carcinoma, which apparently derived from the pelvic mucous membrane.

*Detailed Description of the Stomach and Intestines.*—Stomach considerably distended, its mucosa smooth and covered with mucus. Right below the pylorus the duodenum showed a diffuse dilatation with a marked bulging toward the liver. There were two diverticula in the wall of the duodenum located to the right and left of Vater's ampulla, separated by a thin septum, and in the upper part of this the opening of the common duct was found. These diverticula were adherent to the head of the pancreas from which they could not be separated without an injury to their wall. The pancreas was of medium size and of regular structure. Width of the pylorus 5 cm. Width of the duodenum above the diverticula 12 cm. Width at the level of diverticula 9 cm., and below diverticula 8 cm.

In studying the literature on duodenal malformations, reports of about 250 cases of duodenal atresia could be collected. However, how seriously we can accept this low figure is questionable, because while atresia is by no means a frequent condition, Theremin, for instance, reports as many as nine

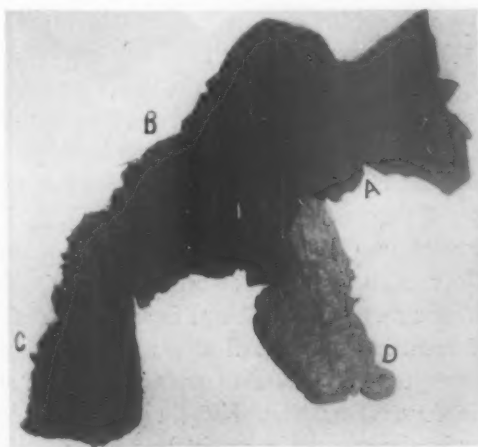


FIG. 2.—Diverticule of Duodenum. A, Pylorus; B, Diverticulum; C, Jejunum; D, Pancreas.

cases out of 150,000 births, which would indicate that more atresias occur than find their way into medical literature.

Statistics regarding duodenal diverticula also present a discrepancy inasmuch as many pathologists encounter it only rarely, while men like Grant and Baldwin report a surprisingly large number of cases. These two above-mentioned men conducted a specific search for diverticula in all their autopsies and Grant states his findings to be as high as 16.2 per cent. and Baldwin's were 13.3 per cent.

Returning to duodenal atresia, its origin has been attributed to many different causes and the opinions of those who have made research into it are widely diversified.

The very earliest explanations of atresia have been based on the belief that the intestines develop from a segmented tube and that there, where these segments failed to unite, atresias occurred. But now embryological studies have proven definitely that the intestines develop from one continuous tubal organ.

Wyss and MacDonald theorize that developmental error or primary aplasia of the vessels causes atresias. But this statement is far from being convincing and it is, to say the least, just as possible that obsolescence of the vessels is the consequence and not the cause of faulty intestinal development.

Other alleged causes of atresia include: Pressure of enlarged liver or pancreas (Christeller, Serr), cysts of the fossa ileocecalis (Schott), malformation of the mesocolon (Hess), hypertrophy of the intestinal folds (Hammer, Schnitzlein), lack of bile flow (Forrer), hæmorrhage, tumors, thrombosis, etc. All these statements are scarcely substantiated and the changes observed are more likely to be merely coincidental than causative factors. Steintal, Kirschner and Thorel all believe intrauterine enteritis to be the cause of intestinal occlusion. Fiedler has claimed that foetal peritonitis is the cause of atresia, yet in most cases no signs of adhesions, bands or scars could be seen. In our own case, although there were adhesions present, no relationship could be demonstrated between the bands and the dehiscence of the small intestines.

In a few cases of atresia cocci were found in the tissues (Markwald). In others, round-cell infiltration and signs of hæmorrhages were present which might point toward an infection as the cause. But it seems highly improbable to accept infection as the responsible factor of congenital atresia because the inflammatory changes are too insignificant. It is much more probable that they were secondary. Syphilitic infection can be dismissed also from our consideration as the children are born at term and are well-developed and show no other signs of lues.

Chiari, Brown and Karpa make an intrauterine intussusception responsible, but this has been refuted by Kuliga, firstly, because intussusception was found only in a few cases and therefore does not warrant its application as a general rule, and secondly, because the type of atresia found in those few cases of intussusception differed from the usual picture of the condition.



## ATRESIA OF THE DUODENUM AND DUODENAL DIVERTICULA

Kuliga after examining critically all the reports on atresias published up to 1903, and after a careful study of his own cases is at a loss to give a conclusive explanation but is inclined to believe in a developmental deviation from the normal.

Kuliga's suggestion is justified by the fact that the duodenum and those other parts of the small intestine where occlusions occur are the site of very complicated developmental processes. The duodenum, besides that it takes certain torsions to assume its formation and location, gives off certain buds from which develop the liver and pancreas, analagous to the condition existing in the œsophagus, from which, by means of budding, the lungs develop. Occlusions have occurred on this part of the œsophagus also. Still another site of the small intestine where we sometimes meet with occlusion is the place where the ductus omphalomesentericus enters and is another spot for complicated developmental conditions.

Kuttner, Gartner, Schottelus, Schlegel, Minich and Goode believe that the complicated mechanism of the torsion of the duodenum alone is the cause of congenital atresias.

Tandler has proven by histological examination of young embryos that proliferation of the epithelium is a physiological condition which develops and obstructs the duodenum when the embryo is from six to eight millimetres long. The proliferation reaches its height when the embryo attains sixteen millimetres and, according to Tandler, atresia occurs if this occlusion does not dissolve as it physiologically should, and remains permanent.

But Kuliga opposes Tandler's contention with two arguments. First he says, that according to the present pathological knowledge, there is never any fusion between epithelium-covered surfaces, unless the integrity of the epithelium has suffered some damage due to infection or irritation. This point does not hold. Although it is true that epithelium-covered surfaces do not fuse unless damaged, this does not apply to the embryonal epithelium which has quite different properties from that of the adult, as is seen in the fusion of the epithelium of the hepatic buds, which arise from the common duct and form the liver or the fusion of the mesothelial buds in forming the kidneys and adrenal cortex.

Kuliga's second and apparently quite logical argument against Tandler's theory is, that in some of the cases reported, meconium was found in the intestines distal to the atresia. This would indicate that occlusion occurs in older embryos, and therefore the atresia cannot be due to the proliferation which is present long before meconium develops. There is, however, some circumstantial evidence in favor of what Tandler has named "physiological proliferation," since similar processes were found also in the course of the development of the œsophagus and rectum by Kreuter, and in one case of congenital atresia of the duodenum there were also similar conditions prevalent in the œsophagus and rectum. (Meusburger.)

The review of the various opinions concerning the cause and pathogenesis of atresia seems to indicate that this condition cannot be explained on the

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basis of a single assumption. In the majority of the cases, however, the condition is brought about by developmental errors, among which disturbance of the physiological proliferation of the epithelium, according to Tandler, is the most important.

As to the pathogenesis of diverticula, there is just as little consensus of opinion. We shall confine ourselves to the discussion of those diverticula which occur in the upper part of the duodenum and which can be classed as congenital on the basis of the following arguments: (1) Such diverticula have been observed in new-borns and in children. (2) Even if they are met with in adults, there is usually no evidence of pathological changes which could be made responsible for them.

In the case reported the double diverticulum was certainly not of the so-called tractional variety, and it must be considered as a pulsion diverticulum, similarly to the congenital diverticula mentioned above.

Pulsion diverticula are explained on the basis of local weakness of the intestinal wall and increased intrainestinal pressure. Examination of the diverticulum wall in the case reported showed that the wall was extremely thin and consisted mainly of the mucous membrane with no grossly visible musculature.

Increased intrainestinal pressure can be demonstrated only indirectly. It seems that the excessive distention of the duodenum above the diverticula warrants the assumption of some obstacle in the emptying of this part of the intestine with consecutive increase of pressure therein. There is, however, no actual obstacle present, occluding or narrowing the intestinal canal, nor is there any anatomical evidence of the previous existence of a kink. Thus the question is justified whether such an obstacle did not exist at an early time of the embryonal life, and while this obstacle was dissolved later on, its effect upon the duodenal wall still persists. We are referring here to the occlusion of the duodenum by epithelial proliferation as discussed above.

It is, of course, a hypothesis only, which cannot be substantiated, but this hypothesis is based on fairly sound analogies with other developmental errors of the duodenum. Further investigations of the duodenum in congenital diverticula would be required in order to decide whether atresias of the duodenum on the one hand and diverticula or diffused dilations of the duodenum on the other hand are not dependent on the same cause.

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## TUMORS WHICH MAY EXPAND THE CURVATURE OF THE DUODENUM, PARTICULARLY TUMORS AND INFECTIONS OF THE RETROPERITONEAL LYMPH NODES

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THE diagnosis of tumors of the upper abdomen may be difficult not only from the standpoint of their place of origin but no less from that of their pathological nature. It is the purpose of this paper to call attention to certain of these lesions which, as shown by the X-ray, serve to *expand the normal duodenal curvature*, and to point out the bearing of the deformity on proper treatment.

The writer's interest in the subject of the tumors which produce this characteristic deformation was initiated by his experience with the following case:

CASE I.—*P.B.B.H., Surg. No. 30157. Male, aged fifty-four. Large retroperitoneal erythrocytoma causing abdominal pain, weakness, loss of weight, diarrhœa, vomiting, and late and incomplete jaundice. Upward displacement of the stomach and a wide sweep of the duodenal loop shown by the X-ray. Anterior gastro-enterostomy and entero-enterostomy, followed by deep radiotherapy. Relief of vomiting and jaundice. Disappearance of mass. Uncontrolled diarrhœa. Inanition, death, autopsy.*

D. J. H., an Irish-American salesman, was admitted November 23, 1927, complaining of abdominal pain, diarrhœa and loss of weight. His bowels had been irregular for three years and he had had hemorrhoids. During the year preceding admission he had lost thirty pounds in weight but worked steadily and considered himself well.

Eight weeks before entry he had an attack of diarrhœa accompanied by lower abdominal cramps which persisted irregularly for three weeks. No blood or mucus was noted in the loose stools. Marked constipation followed the diarrhœa and he became conscious of distress in the left epigastric region immediately after each meal. For the two weeks preceding admission he repeatedly vomited large amounts of old and recently eaten food, charged blood and mucus. He finally was unable to retain even liquids, and weakness took him to bed.

Two days before admission he noticed that his relaxed skin was becoming yellow, and for the first time he felt a lump in his abdomen. Just after arrival in the ward he vomited a litre of chocolate-colored, coffee-ground material.

*Examination.*—This showed marked emaciation with a soft, lax, moderately jaundiced skin and yellow scleræ. Peristaltic waves, apparently gastric, could be seen passing repeatedly from left to right across the upper abdomen. There was a moderately tender, nodular, firm, elastic mass, the size of a large fist, in the upper abdomen, slightly to the right of the mid-line. There was a difference of opinion among several observers as to whether this mass was at all movable, but to the writer it seemed to be slightly so.

The mass was not connected with the liver, which could be palpated separately. A laterally displaced, distended gall-bladder could be felt beneath the rounded edge of the liver. There was no evidence of free peritoneal fluid.

From the stomach, 300 c.c. of fluid, containing old blood, was aspirated. It contained 20 per cent. sediment, free acid 46, and total acid 82. The benzidine test was strongly

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positive, and the microscopic examination showed many red blood cells and Opler-Boas bacilli. The stools were clay-colored and chemical tests were negative for bile. Bile was present in the urine, which was otherwise normal. The van den Bergh reaction was direct, prompt and approximately four times the normal (4.05 units), indicating obstructive jaundice. Hemoglobin, 75 per cent. (T); red blood cells 4,200,000. Bleeding time, ten minutes; clotting time, two minutes.

Barium fluoroscopic studies showed a dilated and atonic stomach. The antrum was narrow and displaced upward, while the greater curvature showed irregularities suggest-

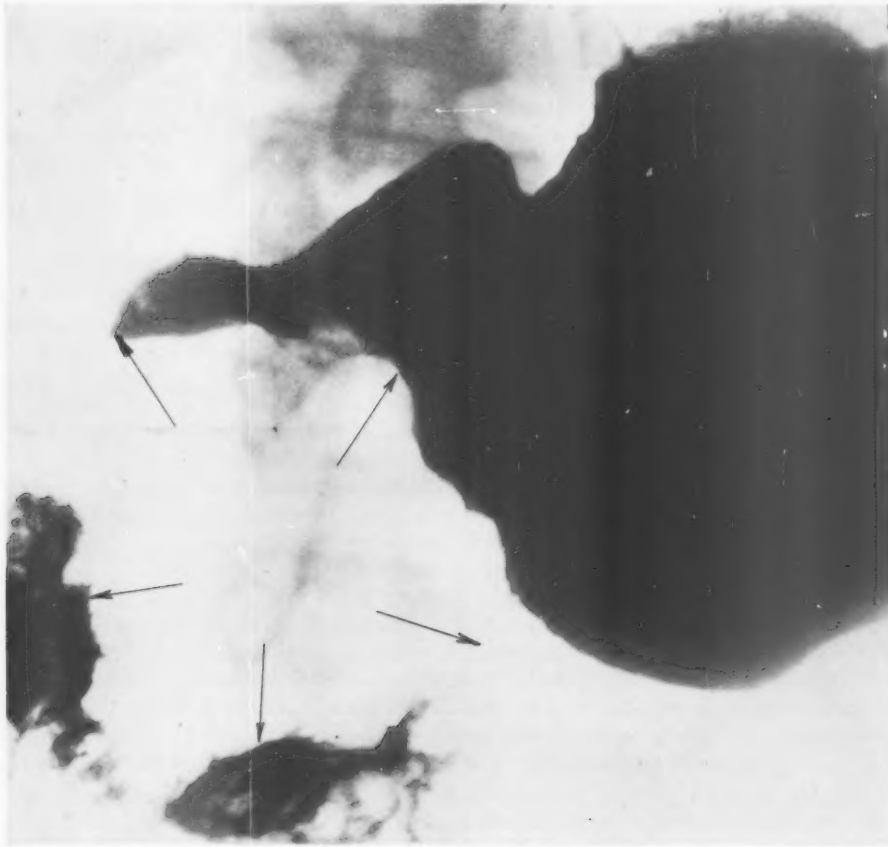


FIG. 1.—Case I. Duodenal loop widely expanded by a large retroperitoneal erythrocytoma involving the lymph nodes in the region of the head of the pancreas.

ing extrinsic pressure rather than intrinsic deformity. There was a six-hour residue estimated at 20 per cent. The duodenal cap could not be definitely outlined, but *the duodenal loop was expanded into a large circle surrounding the palpable mass in the epigastrium.* (Fig. 1.)

*Operation.*—The abdomen was explored under novocaine anaesthesia on December 3, 1927, and a large, firmly anchored, retroperitoneal tumor was found in the region of the head and body of the pancreas. The pyloric antrum, which was evidently adherent to the tumor, was displaced superiorly and anteriorly; the gastrocolic omentum and the transverse colon were pushed forward; and the duodenum was expanded into a widely-curved ribbon encircling the periphery of the tumor. The entire mass was approximately 12 cm. in diameter, nodular, firm, elastic and rubbery.



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There was no free fluid in the peritoneal cavity and the liver was distinct from the mass and free from metastases. There was a tensely dilated, thin-walled gall-bladder, which together with the right lobe of the liver was rotated by the mass to the right.

Inferiorly the tumor appeared to fill the root of the transverse mesocolon and to extend well to the left of the mid-line. Anteriorly it was adherent to the gastrocolic and gastrohepatic omentum, and, in this situation, several enlarged and freely movable lymph nodes were felt. One of these was excised and appeared both grossly and by frozen section to be hyperplastic but free from tumor. From the extremely vascular tumor mass itself, a small piece of tissue was, with difficulty, taken for histological verification.

An anterior gastrojejunostomy with an entero-enterostomy below the level of the transverse colon was made. In the course of this procedure an opportunity was given to observe the lumen of the pyloric antrum, where the mass was adherent, and it was found that the lesion was beginning to infiltrate the gastric mucosa.

Due to the patient's poor condition, any further prolongation of the operation, such as would have been necessitated by an effort to relieve the obvious obstruction to the common duct by a cholecystenterostomy, seemed unwise. Furthermore, the gall-bladder was displaced far from the stomach and the duodenum was partially obstructed so that the procedure would have been of doubtful value.

*Post-operative Course.*—The patient was put on a liquid diet, and with the exception of a single attack of vomiting on the sixth day, he appeared to be doing well. On the eighth day the stomach was aspirated and only 30 c.c. of mucoid, bile-containing material could be obtained. The jaundice decreased in intensity and by the twelfth day, when the stools had begun to regain color, the van den Bergh test showed only 0.6 units contrasted with 4.05 units before operation. At about this time the patient's former tendency to diarrhoea recurred and in spite of scrupulous cleanliness a small decubitus appeared over the sacrum.

On the sixteenth post-operative day a fluoroscopic study with barium showed an irregular, apparently fixed pyloric antrum which was narrowed and without peristalsis. Most of the barium emptied through the anterior gastro-enterostomy. The stoma was movable and was not tender. There was a six-hour gastric residue distal to the stoma estimated at 10 per cent.

A microscopical study of the piece of tissue removed at operation meanwhile showed that the tumor was an unusual one (an erythrocytoma), and, beginning on the nineteenth post-operative day, the patient, under Doctor Sosman's direction, was given four deep X-ray treatments at two-day intervals.\* The first treatment caused no reaction but the second resulted in a rise in temperature, nausea and weakness.

In spite of the fact that the radiation had a pronounced effect on the tumor mass, so that by the thirty-fifth day it was no longer palpable, the patient became increasingly more emaciated and cachectic, the diarrhoea continued, the decubitus enlarged and he died on the thirty-seventh post-operative day (January 9, 1928).

*Autopsy.*—Anatomical diagnoses: Retroperitoneal erythrocytoma (absorbed by radiation), acute fibrinous pericarditis (aseptic), chronic bronchitis, aplastic bone marrow, peritoneal adhesions, emaciation.

The large tumor mass present at the operation five weeks previously had entirely disappeared. The gastro-enterostomy and entero-enterostomy were intact (but there was no functional need for them, as there was no intestinal obstruction).

The fatty tissue around the head of the pancreas and in the transverse mesocolon showed considerable induration, and in it were several button-like nodules which appeared to be lymph nodes, so firmly imbedded that they were dissected out with difficulty. The mesenteric nodes were similar in appearance, not exceeding 1.5 cm. in greatest dimension.

\* Alternating posterior and anterior treatments, directed through the epigastric and upper lumbar regions, were given. All dosages: 30 min., 40 cm., 4 m.amp., 182 kv., 1/2 mm. copper and 1 mm. aluminum screen, 50 per cent. S.U.D., 20 x 20 cm. portal.

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Nothing grossly resembling tumor tissue was anywhere to be seen. The spleen was small and fibrous. The peripheral lymph nodes appeared to be normal.

Microscopical examination by Dr. Henry Pinkerton of the nodules mentioned above showed areas of cellular tissue containing nucleated red cells and more primitive hemopoietic cells. Lymph follicles were absent but there were large phagocytic cells, often laden with hemosiderin.

Comparison with the tissue taken at operation showed a disappearance of the obviously neoplastic hemopoietic tissue then present. It was now largely replaced by fibrous stroma.

Aroused by the peculiar deformation disclosed by the X-ray in the primary examination of the case reported above and with the idea that it might be of significance in the differential diagnosis of lesions in this region, the writer sought in the hospital records for other similarly placed retroperitoneal tumors, with the purpose in mind of making a comparative study of the gastro-intestinal X-ray films in their relation to other symptoms and signs which were soon found to require consideration.

Out of several cases that seemed promising from the clinical histories, four were found in which the typical deformity was either unmistakable on the X-ray films or was clearly described by the röntgenologist in his report. In two of these cases the pathological process was lymphosarcoma, in one metastatic carcinoma in lymph nodes, and in another chronic pancreatitis with cyst formation.

During the course of this inquiry and while Case I was still fresh in mind, a patient was admitted to the ward who proved to have a moderately expanded duodenal loop, but from another and an unusual cause. The history of this case follows:

CASE II.—P.B.B.H., Surg. No. 30548. Female, aged forty-four. Carcinoma (unverified) of head of pancreas with moderate expansion of the duodenal loop, as seen at fluoroscopy, and jaundice. Exploratory laparotomy. Cholecystogastrostomy with relief of jaundice. Improvement in condition and gain in weight.

S. C. F., a school-teacher, was admitted to the medical service on January 16, 1928, complaining of deepening jaundice, weakness and loss of weight. Her general health had been good until seven months before admission, when she began to have distress in the epigastrium and raising of gas shortly after eating. Bicarbonate of soda gave only partial relief. On a single occasion she vomited a small amount of greenish material. There was no hematemesis or melena.

The indigestion continued and two months before admission she had "bronchitis" with sharp pain in the anterior portion of the right chest, night sweats, thin yellow sputum and questionable jaundice. This illness was succeeded two weeks later by a persistent dull pain in the mid-epigastrium and right upper quadrant of the abdomen. She became progressively weaker, markedly emaciated and more jaundiced; and had itching, clay-colored stools and dark urine.

*Examination.*—This showed a small woman whose skin was relaxed, wrinkled, markedly jaundiced, and excoriated from scratching. The enlarged liver and smooth, moderately tender gall-bladder could be felt in the right upper abdomen. A separate, ill-defined, firm, fixed mass, which did not descend on inspiration, was felt in the right epigastric region.

The temperature was normal; the pulse was regular, rate 70-88; respirations were 20; blood-pressure 118-80; hemoglobin 80 per cent. (T), red blood cells 4,700,000, white blood cells 7,200, differential leucocyte count normal, red cells and platelets normal.

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The urine contained a large amount of bile. A stool on admission was light brown, benzidine + + + +; five days later a sample was clay-colored. The bile-index was 50 (normal, 3-10); van den Bergh, direct, prompt reaction, 8.8 units on admission (normal, 0.5-1.5); unchanged one week later. Bleeding time 8 minutes, 35 seconds. Blood Wassermann reaction + + on two determinations. The gastric analysis showed no free acid in any of the specimens and the total acid curve was low.

The barium fluoroscopic studies revealed a low, hypotonic stomach, smooth in outline, with good peristalsis and no six-hour residue. The duodenal cap was medium in size, smooth in outline, not fixed or tender, but it was displaced laterally, and *the whole duodenum formed a circle around an irregular, nodular mass*. The röntgenologist's impression was of a tumor in the head of the pancreas.

*Operation.*—Exploration and a cholecystogastrostomy were carried out by Doctor Cheever on January 26, 1928. The gall-bladder was distended and thin-walled, one and one-half times the normal size, and the liver-edge was rounded and moderately thickened.

A large, firm mass was palpable behind the pyloric antrum in the region of the pancreas, extending well over toward the tail of the pancreas and involving the head of the organ so that it was two to two and one-half times its normal bulk. No distinct nodules could be felt, however, and no enlarged regional lymph nodes were palpated. The tumor was considered to be a carcinoma of the head of the pancreas, but no tissue was removed for microscopic verification.

A large amount of very dark, concentrated bile, containing much mucus, was evacuated from the gall-bladder, but no calculi were found. The common duct was not opened or exposed. A cholecystogastrostomy was performed just proximal to the pylorus.

*Post-operative Course.*—The convalescence was uneventful and the jaundice gradually disappeared. Bile was noted in the stools on the eleventh day, and the patient was discharged improved on February 13, 1928.

A letter from her physician on September 4, 1928, reported that the patient had rapidly regained her appetite and strength, and had increased thirty pounds in weight. She had had no recurrence of her jaundice, but, once in March and twice in July, had had gastric upsets with nausea and vomiting, but no pain. The only pre-operative symptom which had persisted was infrequent night sweats.

The diagnosis of carcinoma of the head of the pancreas in the case reported above is questionable. If the patient continues to improve, a chronic pancreatitis, possibly tuberculous, is the alternative.

The radiographs showing the enormously expanded duodenal loops in Case I (Fig. 1) and in Case V (Fig. 2), to be reported later in the paper, are most striking, and the röntgenologist's descriptions of the fluoroscopic findings in four other cases are equally so. One of the patients, whose case record follows, was seen as early as 1918, while the others were more recently in the hospital:

CASE III.—P.B.B.H., Surg. No. 7954. Male, aged seventy-two. Pain in the abdomen and back. Palpable tumors, expansion of the duodenal curvature seen on fluoroscopic examination, no jaundice. Exploration, probable retroperitoneal lymphosarcoma. No X-ray therapy. Progressive failure. Death at home. No autopsy.

F. C. J., a native-born printer, was admitted on January 4, 1918, complaining of dull pain in the right side of the abdomen and back.

Beginning five months before admission he gradually weakened, lost his appetite and lost weight. A constant ache, occasionally increasing to sharp pain, began in the right upper abdomen and occasionally radiated to the right lower back. During the two months before admission most of his stools were stated by the patient to be tarry, while

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in the out-patient department one month previous to entry, following an exacerbation of pain, a small but definite amount of bile was found in the urine.

*Examination.*—The patient was a well developed, moderately emaciated old man with no jaundice and no enlargement of the lymph nodes. Blood-pressure 166-70. A lobulated, hard mass (size not stated in the history) was felt half way between the umbilicus and the ensiform process, a little to the right of the mid-line, and a rather indefinite tender mass could be felt further out to the right, curving up toward the edge of the ribs. This was not interpreted as the liver or the gall-bladder, and these organs could not be palpated.

The urine was normal. Haemaglobin 75 per cent. (T), white blood cells 12,000. The stomach contents were rancid and contained old food particles. No free acid was found in the fasting, first, second or third specimens, and the total acid ranged from 0 to 30.

Bismuth examination showed that the stomach was normal but that *the duodenum was stretched out around the palpable abdominal mass.*

*Operation.*—Exploration by Doctor Homans on January 10, 1918, under novocaine anaesthesia, showed a hard, very slightly lobulated, retroperitoneal mass in the region of the head of the pancreas. It was several inches thick in an antero-posterior direction and the duodenum was expanded by it, making a long curve around the tumor. The mass became gradually smaller toward the tail of the pancreas. On the surface could be felt one or two fixed, hard lymph glands. One node was removed (this was later found normal on microscopic examination), but no specimen was taken from the growth since the important vessels supplying the transverse colon ran through it.

The gall-bladder was large and rather tense, but could be emptied on pressure. No metastases were seen in the liver and the liver was not enlarged. The stomach, the transverse colon and the other structures in the field appeared normal.

*Post-operative Course.*—The convalescence was uncomplicated but the temperature became irregular and his marked weakness persisted, so that it was necessary to send him home in an ambulance (January 29, 1918).

A letter from his wife stated that he died three weeks after discharge from the hospital. No post-mortem examination was made.

Though the impression gained at operation in the above case was of carcinoma of the head of the pancreas, it would be preferable, on the basis of the clinical history, physical and X-ray findings, to make a diagnosis of a malignant retroperitoneal tumor of some other origin. It will be noted that there was no jaundice (except a transient attack of slight degree one month before admission), that the abdominal mass was palpable, and that the duodenum was "stretched out" around the mass. Such extensive carcinoma in the head of the pancreas itself would almost surely cause marked jaundice. This was probably a case of retroperitoneal lymphosarcoma or metastatic carcinoma, though, unfortunately, no tissue for verification was obtained at the operation.

An interesting instance of expansion of the duodenal circle by a chronic inflammatory process, with necrosis and cyst formation, is found to be recorded in the following history of a patient admitted five years later:

CASE IV.—P.B.B.H., Surg. No. 20137. Male, aged forty-one. History of pulmonary tuberculosis. Abdominal pain, melena, anorrexia. No jaundice. Palpable abdominal mass which projected the stomach upward, expanded the duodenal circle, and displaced the transverse colon downward, as seen at fluoroscopy. Exploration showed

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*chronic pancreatitis (? tuberculous) with necrosis and cyst formation. Draining. Recurrence of old pulmonary symptoms suggesting phthisis.*

M. W. was admitted to the surgical service on November 16, 1923, complaining of abdominal pain. Eight years previously he had been in bed for three months with pulmonary tuberculosis and pleurisy with effusion. This illness was accompanied by night sweats and a chronic cough with which he raised large amounts of bloodless sputum. He lost weight, became exhausted, and was sent out West for a year's vacation. He then became a cattle-rancher, improved and had no more pulmonary symptoms.

Three months previous to admission he began to have mild attacks of indigestion about once a week, none of them sufficiently severe to keep him from work, and, as a rule, readily relieved by soda.

Beginning two months before entry he occasionally noticed liquid, red blood in his stools and two weeks before admission he had a dizzy spell, accompanied by a cold sweat and sharp, cramp-like pains over the whole upper abdomen. At this time he vomited several times but there was no blood in the vomitus. After this attack he continued to have generalized pain in the upper abdomen, occasionally quite sharp, and his appetite became poor.

*Examination.*—The patient was normally developed and showed little evidence of loss of weight. The skin was not jaundiced and there was no enlargement of the peripheral lymph nodes. Blood-pressure 130-80.

The abdominal panniculus was thick and the abdomen was prominent, especially in the epigastrium, where a large, firm, smooth, insensitive mass was felt completely to fill this region. It moved slightly with respiration, was fixed posteriorly and did not seem to be adherent to the liver or the anterior abdominal wall. The liver itself could be felt about two centimetres below the costal margin, but the gall-bladder was not palpable. The lower abdomen was normal and no free peritoneal fluid could be detected.

The temperature, pulse, and respirations were normal. The urine was negative; benzidine test on stools, —, —, — (three determinations); bile +; no parasites were seen. The blood Wassermann was negative; hæmoglobin 85 per cent. (T); white blood cells 7,700. The differential blood count, blood smear examination and gastric analysis were not carried out.

Barium fluoroscopic studies showed a large filling defect on the greater curvature side of the pyloric antrum. *The duodenum was flattened and deformed and swung widely around the palpable mass.* At six hours there was no gastric residue and the head of the barium column was in the transverse colon. The latter was narrowed and was pressed down by the mass felt in the abdomen. The röntgenologist gained the impression of a mass arising from the pancreas.

*Operation.*—Exploration by Doctor Cheever on November 19, 1923, disclosed a small amount of thin, serous, free peritoneal fluid, and an enlarged, smooth liver. There was a large mass behind the stomach and transverse colon, both of which were displaced forward by it. The gall-bladder was normal and flaccid but was adherent to the gastro-hepatic omentum against the mass.

On opening the pancreatic capsule through the gastrocolic omentum, a tablespoonful of necrotic, bloody, nearly black, cystic fluid escaped and was immediately cultured. Several other small pockets containing similar fluid were broken into and some strips of partially degenerated tissue were saved for histological examination. No enlarged lymph nodes and no areas suggesting tuberculous caseation were seen. The pancreas was drained.

*Post-operative Course.*—For several days there was a moderate discharge of dark, irritating fluid from the wound. The temperature slowly subsided and the patient was discharged on January 14, 1924, a little less than two months after operation, with a completely healed wound. The mass had disappeared and there was no evidence of pancreatic insufficiency.



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The cultures taken from the pancreas at operation produced no growth. The microscopic sections showed necrotic, chronically-inflamed pancreatic tissue with no definite evidence of tuberculosis.

A letter from the patient's wife one year after discharge told of a recurrence of the pulmonary symptoms. He had had, however, no further complaints referable to the abdomen.

The chronic pancreatic inflammation in the above case resulted in necrosis and the formation of multiple areas of liquefaction. It is probable that this process, if allowed to progress, would have resolved itself into a single large cyst in the head of the pancreas, resulting in still further expansion of the duodenal curvature.

Among all of the films showing expansion of the duodenal arc, that from the following case (Fig. 2) is the most striking:

CASE V.—*P.B.B.H., Surg. No. 22834. Male, aged fifty-eight. Displacement of the stomach and expansion of the duodenal loop by a large retroperitoneal tumor, probably lymphosarcoma. Exploratory laparotomy. Deep X-ray therapy. Death at home. No autopsy.*

J. H. R., a Canadian truckman, was admitted to the surgical service on December 22, 1924, complaining of swelling of the abdomen and of the right leg. For thirty-two years he had had "chronic dyspepsia" and occasionally he had been awakened during the night by epigastric pain which was relieved by massage of the abdomen and a drink of ginger tea. No relation of the pain to his meals could be elicited. Soda and an ulcer diet gave no relief. He had never been jaundiced.

His present illness began three months before admission with painless swelling of the right ankle and leg. For six weeks he had noticed fulness of the abdomen and oedema of the scrotum. More recently he had become dyspnoeic. He gave no history of loss in weight or strength. His habitual slight constipation had become more marked in the later three or four weeks and he had had occasional mild colicky pains through the lower abdomen.

*Examination.*—This showed a short, stocky individual with soft skin and distinct cachexia, but no jaundice. In the epigastrium between the xiphoid process and the umbilicus there was a mass the size of a man's fist. This was firm, roughly nodular, slightly tender, fixed, and did not move with respiration. The liver was not felt, possibly due to the moderate distention of the abdomen with fluid. Rectal examination was negative.

The temperature was 98°, the pulse 64, respirations 20. Haemoglobin 95 per cent. (T), red blood cells 4,600,000, white blood cells 8,100. The differential leucocyte count was normal. The urine showed a few white cells; specific gravity 1015; no bile was present. The stools were normal, contained bile and showed no gross, microscopic or chemically detectable blood on repeated examinations. No blood and no free hydrochloride was found in any of the specimens obtained by tube from the stomach, and there was a very low total acid curve.

The colon was normal by barium enema, but a gastro-intestinal fluoroscopic study showed, with the patient in the prone position, that the greater curvature of the stomach was arched upward, suggesting pressure by an intra-abdominal mass about in the mid-line. The duodenal cap was normal but *the duodenal curvature made a wide sweep around the periphery of the mass.* (Fig. 2.) There was no gastric stasis and peristalsis was normal.

*Operation.*—Exploration by Doctor Cheever on January 5, 1925, disclosed a small amount of free, serous, straw-colored fluid in the abdomen. The liver and gall-bladder appeared normal. The portal vessels on the surface of the viscera and through the

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mesenteries were dilated and dark. An irregular, diffuse tumor presented behind the stomach and transverse colon. It arose behind and below the pancreas, which was itself normal, and extended to the right and left, obscuring the hilus of the left kidney. There were many soft, enlarged lymph nodes in the mesentery of the proximal jejunum and one of these showed after removal, both by immediate frozen section and by a later more careful study, lymphoid hyperplasia, but no malignancy.

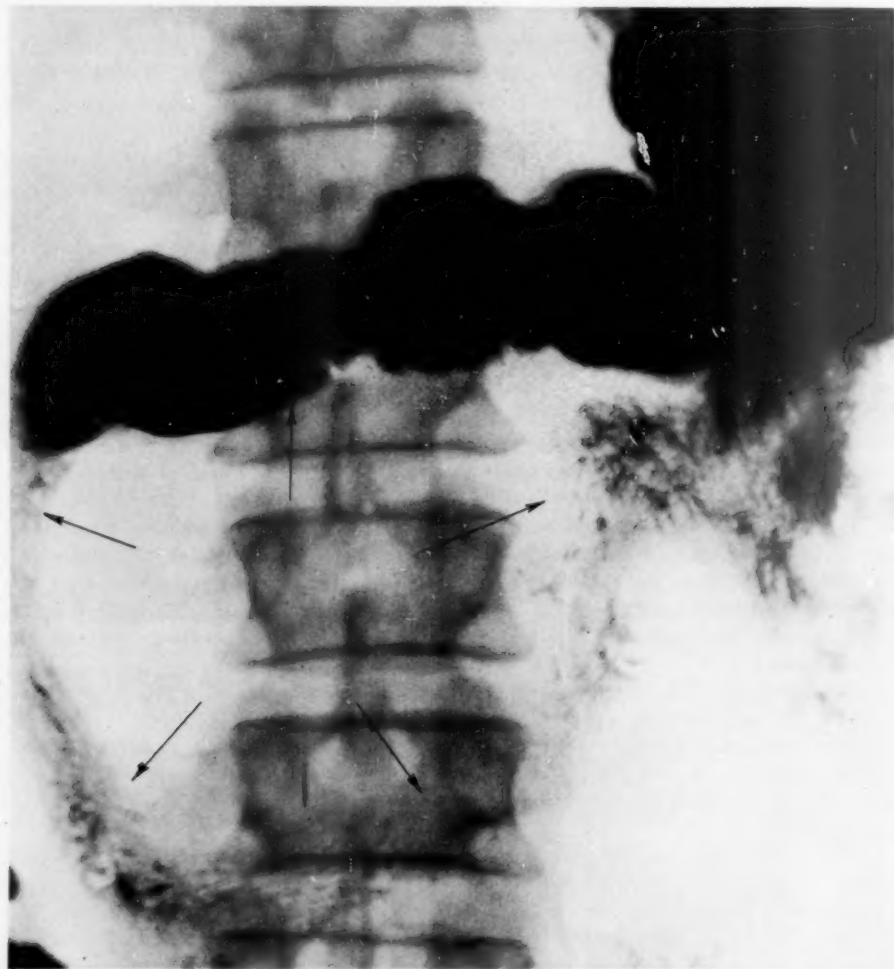


FIG. 2.—Case V. Marked expansion of the duodenal arc by a mass of enlarged retroperitoneal lymph nodes.

After healing of the undrained wound the patient was given two deep X-ray treatments.† He was discharged from the hospital on January 22, 1925, and returned for X-ray therapy on February 11, March 4, March 25, and April 3.‡ The abdomen became well tanned and the mass became less distinct to palpation. Approximately three and one-half

† (1) Epigastric area, anteriorly, 20 min., 12 in., 6 m.amp., 9 in.-spark-gap,  $\frac{1}{4}$  mm. copper and 1 layer sole-leather, screen; (2) the same dose the following day, posteriorly.

‡ The same dosage as before was used and alternating anterior and posterior treatments were given.

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months after his operation the patient became too ill to come to the hospital, so that no further radiotherapy was given.

A letter from a relative told of a gradual failure in health, with excessive pain in the back and legs, epistaxis, sweats, weakness, and loss of weight, which led up to his death on August 14, 1925. No autopsy was performed.

The Röntgen treatment in the last case reduced the size of the abdominal mass, but had no appreciable effect in prolonging life. It is quite possible that exploration, which, in the light of our present knowledge of the tumors which cause an expansion of the duodenal loop, is unnecessary in such cases, considerably weakens the patients, and contributes to their early exhaustion before the favorable effects of the X-ray therapy can be manifested.

In the final case encountered, in which a marked expansion of the duodenal arc was described, the deformity was due to a mass of metastatic carcinomatous lymph nodes in the region of the head of the pancreas. The record follows:

CASE VI.—*P.B.B.H., Med. No. 28695. Male, aged thirty-three. Embryoma of right testicle recurrent in retroperitoneal lymph nodes. The large mass caused elevation of the stomach and wide expansion of the duodenal loop as seen at fluoroscopy. No jaundice. Deep X-ray therapy with relief of abdominal pain and disappearance of mass. Recurrence of pain in abdomen and right leg one year later. Emaciation; spontaneous fracture of right thigh. Death; no autopsy.*

S. G. B., a salesman, was admitted to the medical service on October 5, 1926, complaining of lumbar backache. A right orchidectomy for "embryonal carcinoma" had been performed in a nearby city on September 28, 1925, following which he had there been given several X-ray treatments which were continued up to the time of admission. §

During the six weeks preceding his entry to the hospital he had suffered, particularly at night, from sharp pain to the right of the umbilicus, radiating through to the lumbar region and into the left testicle. Eructations of gas from the stomach had been troublesome but there had been no vomiting. He had eaten little food and had lost moderately in weight.

*Examination.*—This showed a heavy, robust individual. The right testicle had been removed and there was no local recurrence of the tumor. Between the right costal margin and the umbilicus there was felt a slightly elongated, smooth, hard, moderately tender, fixed mass about the size of a large gall-bladder. It was not considered to be this organ, however, since it did not descend with inspiration and since the liver could not be palpated. There were no signs of free fluid in the peritoneal cavity.

Cholecystograms disclosed a normal gall-bladder. There was no röntgenologic evidence of metastatic tumor in the chest or spine. The barium fluoroscopic studies showed the stomach to be high and hypertonic with sluggish peristalsis, and no six-hour residue. It was displaced upward and the antral portion of the greater curvature was concave, due to pressure by an extrinsic mass. *The duodenum emptied downward and swung widely around the same mass.* There was no duodenal or pyloric obstruction.

The temperature was normal; blood Wassermann ++, +, ++ (three determinations). The urine was normal and contained no bile; stool normal; icterus index 5, 5 (normal). Hæmoglobin 90 per cent. (T), red blood cells 5,000,000, white blood cells 6,900. The differential leucocyte count and blood smear were normal.

§ Ten treatments between October 27, 1925, and August 25, 1926, directed in rotation, anteriorly and posteriorly, through the lower right abdomen, and right groin and scrotum. All dosages: 10 min., 12 in., 5 m.amp., approximately 150 kv., screening not noted on record.

The patient was discharged to the care of his local physician who supervised the giving of a series of antiluetic and deep X-ray treatments, the latter similar to those he had had before admission to the hospital. A note written one year after discharge, by Doctor Levine, under whose care the patient had been while in the hospital, stated that the abdominal mass had disappeared and that the patient then had no complaints. A recent letter from his physician related, however, that shortly after Doctor Levine's note was written the patient began to fail, became extremely emaciated and suffered extreme pain in the right leg and knee. In April, 1928, he fractured his right thigh while taking a bath, and was removed to a hospital where he died six months later. No autopsy was performed.

In order to gain a better idea as to the probability of expansion of the duodenal arc by carcinoma of the head of the pancreas, the autopsy records of the patients who had died of this disease in the hospital were briefly reviewed.

In most of these cases the tumors were quite small, but in three instances they were of moderate size, recorded as  $16 \times 9 \times 7$  cm.,  $6 \times 6$  cm., and  $6 \times 3 \times 3$  cm., respectively. In the first and third of these cases an attempt had been made to make a diagnosis by gastro-intestinal barium fluoroscopic studies and in both instances no abnormality of the duodenum was seen.

However, in the first case, which concerned a New England housewife, aged forty-one, the X-ray observation was made almost four months before death. During this time the tumor might well have enlarged considerably. In the third case, that of a negro, aged fifty, the tumor was hardly large enough to cause definite expansion of the loop. In the second instance, recorded of a prison-guard, aged sixty-five, the patient, by the time his tumor had grown large enough to possibly expand the duodenal loop, was far too sick to withstand barium studies.

All three of these autopsied patients had histories and physical signs quite typical for carcinoma in the head of the pancreas. In each the early onset of progressively deepening jaundice constituted a prominent feature, and equally consistent was the fact that in none of them was an abdominal mass definitely palpated.

*Discussion.*—In order to expand the duodenal curvature, a tumor, *e.g.*, a cyst of the head of the pancreas, must be fixed within the duodenal arc. Except by direct invasion of the pancreas with consequent fixation, a tumor of the transverse colon could not cause the deformity, for the mass of tumor would more naturally project forward in the direction of least resistance. An omental cyst, likewise, could not conceivably cause this expansion. Similarly, a mass in the region of the gall-bladder might cause a pressure defect in the duodenal cap, but would not expand the loop. Likewise, a hydronephritic kidney would be more likely to rotate the duodenum anteriorly or medially, though it is possible that a malignant tumor of the right kidney or upper ureter might so invade the pancreas or retroperitoneal lymph nodes as to cause expansion of the duodenal circle.

Enlargement of the curve of the duodenum can occur, then, only when some fixed and expanding lesion in the region of the head of the pancreas is

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present. The pathological processes which may cause this deformation are consequently limited to retroperitoneal tumefactions in this situation, and of the following possible sources and varieties:

<i>Tissue</i>	<i>Tumor</i>
Lymph vessels and glands.....	Chylous cysts; lymphangioma; lymphoblastoma (including lymphosarcoma and Hodgkin's disease); tuberculosis of lymph nodes; metastatic malignancy in lymph nodes.
Blood vessels and cells.....	Erythrocytoma; endothelioma; retroperitoneal hæmorrhage or "pancreatic apoplexy" with blood clot; aneurysm of pancreatico-duodenal or superior mesenteric artery.
Nerves .....	Neuroblastoma.
Fibrous tissue .....	Fibroma, lipoma, etc.; fibrosarcoma, etc.
Glandular tissue .....	Pancreatic cysts (with or without infection, calculi or tumor as the cause); pancreatitis, chronic (including tuberculous pancreatitis); carcinoma of head of pancreas (acini or islands); carcinoma, lower segment common bile duct or ampulla of Vater; malignant right renal or ureteral, colonic or gastric tumors with direct invasion of the pancreas; benign and malignant tumors arising from cell rests (Wolffian body, etc.); echinococcus cysts of the pancreas (or surrounding tissues); tumors or infections invading the pancreas from the posterior parietes, spine, etc.

It will be seen at once that most of these lesions that serve as possible causes of expansion of the duodenal loop are rare. The incidence among the cases reported, collected over a considerable period, may be taken, reasonably, as an indication of the more common lesions which cause the deformity. These group themselves readily into (1) lesions originating outside of the pancreas, and (2) those arising within the pancreas itself.

It is significant that to the first group belong the three cases which, of the six reported, caused the most marked expansion of the duodenal arc (Cases I, V and VI, Figs. 1 and 2). This expansion, in all three instances, was due to the enlargement of lymph nodes in the region of the head of the pancreas, in one case due to an erythrocytoma affecting the lymph nodes, in the second by a lymphosarcoma and in the third by carcinoma, metastatic in the lymph nodes from a malignant tumor of the testicle.

Of all the possible extrinsic causes of the deformity in question the lymph-node tumors and infections, including Hodgkin's disease and tuberculosis, are undoubtedly by far the most common.

Lesions originating in the pancreas itself apparently far less often produce significant degrees of the deformity. There is a good reason for this in that the most common lesion of the head of the pancreas, carcinoma, obstructs the common bile duct, dams back the external pancreatic secretion and causes death before the tumor reaches a size sufficient to expand the duodenal curva-



ture. Whereas retroperitoneal sarcoma or tuberculosis is likely to produce a large mass which, first, displaces the common bile duct but does not occlude it and consequently causes little or no jaundice, and which, second, in growing, expands the duodenal arc into a narrow ribbon around its periphery, carcinoma of the head of the pancreas usually produces a small mass, early, deepening, complete jaundice, and little or no expansion of the normal duodenal curvature.

Chronic pancreatitis, the second most common disease of this organ, appears occasionally to result in a sufficient enlargement of the head to expand the duodenal arc; (an example is to be found in Case IV). This it does by the inflammatory infiltration of the pancreatic tissues and by the formation of cystic collections of fluid. However, the cysts are not very common and they more often occur in the body of the organ than in the head, in which case they do not result in expansion of the duodenal arc.

For the same reason that carcinoma arising in the head of the pancreas does not often result in significant expansion of the loop, carcinoma of the lower segment of the common bile duct or of the papilla of Vater, would hardly be expected to cause the deformity. These tumors which are in such intimate relation to the duodenal wall are more likely to invade it, causing irregular deformities or constricting and partially obstructing it. Nevertheless, slight expansion may occur in conjunction with the deformities, as is shown by a case of carcinoma of the pancreas reported by Püschel<sup>1</sup> (Fig. 3, p. 498) in which there was partial obstruction of the duodenum by the tumor growth, apparently accompanied by some expansion of the loop; likewise, as shown by Assmann's note<sup>2</sup> (Fig. 569) of a case, presumably of carcinoma arising at the papilla, in which there was minimal expansion of the loop in addition to the more common irregularities which these tumors may cause in the duodenum.

The diagnosis by X-ray visualization of lesions arising within the head of the pancreas is, then, with the exception of large cysts in this situation, seldom accomplished, because of the small size of the tumors as compared with those of extrinsic origin of which the lymph-node tumefactions are the most numerous.

Expansion of the curve of the duodenum must be quite marked before it can be considered definitely pathologic by X-ray visualization. The normal variations in the curvature and length of the loop are considerable (David,<sup>3, 4</sup> Dorner,<sup>5</sup> Chaoul,<sup>6</sup> Case,<sup>7</sup> Herrnheiser,<sup>8</sup> Palmieri,<sup>9</sup> Bécélère and Porcher<sup>10</sup>), and Buckstein's<sup>11</sup> studies appear to show that there is no constant relationship between habitus and the appearance of the curve.

Whereas a mass of diseased lymph nodes which extends into the region of the head of the pancreas, or a cyst in this situation, usually expands the duodenal circle, it should be recognized that a similar mass or cyst is just as frequently encountered which arises at the base of the transverse mesocolon or within the body of the pancreas, and which causes a pressure defect in the greater curvature of the stomach and in the transverse colon, but does not affect the duodenum. Occasionally a mass of enlarged lymph nodes is so placed as to rotate the entire duodenum and pyloric antrum upward and to

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the left. Many variations of these extrinsic deformities of the stomach, duodenum, jejunum and colon may, of course, be encountered (Schlesinger,<sup>12</sup> Quimby,<sup>13</sup> Albu,<sup>14</sup> Zondek,<sup>15</sup> Christopher,<sup>16</sup> Gross, O.,<sup>17</sup> Piergrossi,<sup>18</sup> Buckstein,<sup>19</sup> Muzii<sup>20</sup>).

Previous to the operation, the author presumed that the patient in Case I had a carcinoma of the pancreas. Two facts were against this diagnosis, however: first, the late onset and the incomplete character of the jaundice; and second, the large size of the abdominal mass. Similarly, in Case III, the operator's impression, even at operation, was that of carcinoma of the head of the pancreas, though, as has been pointed out in connection with the history, the evidence (on the same basis as in Case I) is preponderantly in favor of lymphoblastoma.

In further support of this contention it has been shown by Minot,<sup>21</sup> in his study of a large series of cases of lymphoblastoma, that, though 25 per cent. of his patients had as their initial symptom one referable to the abdomen, jaundice if it appeared at all was a late manifestation. He notes, however, as an exceptional instance, the occurrence of jaundice as a primary symptom in one of his cases of abdominal Hodgkin's disease, and refers to Pepper's<sup>22</sup> clinical case. In addition, Rutecki,<sup>23</sup> Stahr and Synwoldt,<sup>24</sup> and Day<sup>25</sup> have described unusual cases of lymphosarcoma or Hodgkin's disease presenting obstructive jaundice as a primary or very early symptom, usually due to compression of the common bile duct by enlargement of adjacent lymph nodes, or, as in Day's example, to a mass which included and largely replaced the head of the pancreas. Likewise, the possibility of the occurrence of early jaundice as a result of the enlargement of tuberculous lymph nodes similarly situated has been suggested by Roepke.<sup>26</sup> Also, in cases of retroperitoneal tumor, early and extensive metastases to the liver might cause jaundice as an early symptom, but this must occur very rarely as I am unable to find a report of any specific instance in the literature.

This much may be said, as a rule, of jaundice in relation to these tumors which expand the duodenal curvature, that, in the case of tumors arising in the neighborhood of the head of the pancreas and in instances of slowly growing pancreatic cysts not accompanied by much inflammation, jaundice, if it occurs at all, appears late in the disease and the common duct obstruction is incomplete, whereas in the presence of carcinoma in the pancreas itself or carcinoma arising in the papilla of Vater or the lowest segment of the common bile duct, the jaundice appears early in the disease and progressively deepens due to complete common duct occlusion.

Metastatic carcinoma in the retroperitoneal lymph nodes may form a large mass in the region of the head of the pancreas. The history of a patient with metastases from a tumor of the testicle which caused partial stenosis of the duodenum is related by Jonas.<sup>27</sup> A similar tumor may, as in Case VI in this paper, result in marked expansion of the duodenal loop.

Without resort to special methods for duodenal X-ray visualization, any significant degree of expansion of the duodenal arc is readily demonstrable

during a routine gastro-intestinal fluoroscopic study, provided that the röntgenologist habitually insures that the duodenum is made to fill with barium and that he places the patient in the positions necessary completely to visualize it. The expansion is usually best seen with the patient in a right prone position while moderate pressure is exerted against the abdominal mass which causes the deformity. The radiologist must, naturally, be familiar both with the limits of normal variation of the loop and with the many deformities, other than the expansion with which we are concerned, which may occur.

The rapid and complete disappearance of the abdominal mass in Case I under deep X-ray therapy was astonishing. It is probable that radiotherapy alone, without the gastro-enterostomy, would have relieved the patient's duodenal obstruction, just as it relieved his jaundice for which nothing was done at operation, and the unnecessary operation undoubtedly reduced his strength. In retrospect, based on our present knowledge of the lymph-node tumors which most frequently cause expansion of the duodenal curvature, the exploratory operations in Cases III and V as well as in Case I might better have been omitted and replaced by primary X-ray therapy. Of course, even in these cases of expansion of the duodenal loop, when there is reason to suspect an active inflammatory process (tuberculous or otherwise) in the pancreas or adjacent lymph nodes, where a pancreatic cyst, which might be drained, is presupposed, or when there is marked jaundice which does not quickly respond to deep X-ray therapy, operation is indicated. A degree of duodenal obstruction, complete enough to require immediate gastro-enterostomy without a trial of the effect of radiotherapy on the obstructing mass, would be extremely unusual.<sup>†</sup>

In Case I the erythrocytoma was quickly absorbed by the deep röntgen-therapy and the histologic comparison between the tissues removed at operation and at autopsy showed a marked reduction in the number of the tumor-forming blood elements and an apparent actual increase in the amount of fibrous-tissue stroma. The change was similar to that seen in a large retro-peritoneal lymphoblastoma, which had been intensely irradiated between the time of exploration and death, described by Mathé.<sup>28</sup>

*Literature.*—Among his many contributions to the early studies of gastro-intestinal radiology, Holzkecht<sup>31</sup> in 1910 suggested the possibility of observing changes in the form of the duodenum after the oral administration of bismuth. In the same year, Crane<sup>32</sup> proposed an attempt to diagnose tumors in the head of the pancreas through observation of the duodenum during bismuth X-ray studies.

Shortly afterward Skinner<sup>33</sup> described a technic by which he directly filled the duodenum with a bismuth mixture through a duodenal tube devised

<sup>†</sup> The X-ray studies and treatments in all of the more recent cases reported in this paper have been carried out under Doctor Sosman's direction, and the treatments have conformed in general to the principles outlined by Desjardins<sup>29</sup> and Evans and Leucutia.<sup>30</sup>

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by Gross,<sup>34</sup> in order more clearly to visualize the organ. He suggested that his method would be useful for outlining the head of the pancreas.

There followed in 1913, 1914 and 1915, several papers by David<sup>3, 4, 35</sup> in which he set forth a similar technic by which he was able to visualize instances of duodenal obstruction, while Chaoul<sup>6</sup> in 1916 demonstrated, by reproducing many illustrations of his X-rays showing variations in the normal and pathologic duodenum, the efficacy of his simple technic for fluoroscopic observation. In carrying out his method he turned the patient in a right prone position and temporarily obstructed the duodenum by abdominal compression of its third portion against the spine, while the duodenal loop filled, consequently, with bismuth from the stomach. This is essentially the technic routinely used in our own X-ray department to detect variations in the form of the duodenum. A technic more recently proposed by Buckstein<sup>36</sup> is a modification of that described by Skinner.<sup>33</sup>

Several isolated reports of tumors which had caused enlargement of the duodenal curvatures have been found scattered in the literature. One of these reports [Case 7 (Fig. 10)] concerned a large pancreatic cyst around which the duodenum curved in the shape of a "C", while in Assmann's case<sup>2</sup> (Fig. 385) there is shown a deformity, though not typical, of the loop, by a cyst presenting behind the pyloric antrum and the first portion of the duodenum. In an instance reported by Schwarz<sup>37</sup> a large pancreatic cyst pressing against the greater curvature of the pyloric antrum caused partial pyloric stenosis. It is conceivable that had he used Skinner's method (v.s., 33) of X-ray visualization, it would have been possible to demonstrate the expansion of the duodenal curvature which was almost certainly present.

In a general discussion of tumors occurring in the region of the head of the pancreas, Püschel<sup>1</sup> (Fig. 8, p. 503) states that not only masses of enlarged sarcomatous lymph nodes, but also those of tuberculous origin, may cause displacement of the duodenal loop. Letulle and Aubourg<sup>38</sup> report an instance in which "lengthening of all the segments of the duodenum was dependent on an enlargement of the duodenal arc" by a mass of tuberculous lymph nodes in the region of the head of the pancreas, while, finally, Assmann<sup>2</sup> (Fig. 663) speaks of the duodenum "stretched out around" a tuberculous mass.

## CONCLUSIONS

(1) An expansion of the duodenal arc should be regarded as an important sign in the diagnosis of immovable tumors in the region of the head of the pancreas.

(2) Lesions of the pancreas itself, however, are not the most common cause of the deformity, for though it is known to be produced by pancreatic cysts of large size and even to be associated with pancreatitis, a carcinoma of the head of the pancreas rarely reaches a sufficient size to do more than cause irregularities in the outline of the loop, as seen by fluoroscopic visualization with barium.

(3) The expansion is most frequently caused by a pathologic process involving the retroperitoneal lymph nodes, such as lymphosarcoma, Hodgkin's disease, metastatic carcinoma or tuberculosis. These lesions usually produce large palpable masses and little or no jaundice, in sharp contrast to the small masses and the early obstructive jaundice which followed the onset of carcinomas of the head of the pancreas.

(4) If there is any doubt as to the pathologic nature of a tumor causing the deformity in question, even should the mass be associated with partial intestinal obstruction or jaundice, operation should be withheld until the effect of radiation has been determined, for many of the lesions producing expansion of the duodenal arc are favorably affected thereby, making operation unnecessary.

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## BENIGN TUMORS OF THE DUODENUM\*

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FROM THE MAYO FOUNDATION

THE rarity of benign tumors in the duodenum as compared with benign tumors of other portions of the gastro-intestinal tract, and the fact that they do not necessarily produce symptoms, are the chief reasons why they are so seldom encountered in surgical practice. They may be responsible for serious symptoms, particularly hæmorrhage; they may be overlooked and they are easily removed; thus they are of significance clinically, and of interest from a surgical standpoint.

King's<sup>1</sup> review of the earlier cases (1917) was based on the report of Heurtaux, who, in 1899, reviewed fifty cases of benign tumor of the intestine. To these King added sixty-nine cases, bringing the total to 119. Of these, five were in the duodenum: one fibroma (Vaccari), one lipoma (Notan-Larrier and Roux), one telangiectatic tumor (Wesener), and two tumors, myomas or fibromyomas (Virchow and Wesener). A case in which two neurofibromas, associated with generalized neurofibromatosis, were found in the duodenum, was also reported; in at least three of the five cases the tumors were found incidentally at necropsy; they had not produced symptoms.

We have noted eight additional cases in the literature and have added four cases of our own. Weishaupt<sup>2</sup> (1916) found an adenomyoma of the duodenum in a child aged eleven days. The glandular structure was similar to that of Brunner's glands. Meisel's<sup>3</sup> case (1921) was an adenomyoma in a woman aged fifty. A diagnosis of duodenal ulcer had been made by the Röntgen-ray. Exploration revealed a small hard tumor within the first portion of the duodenum. The top of the tumor was ulcerated and the base showed round-cell infiltration. The patient was well six months after the operation. Van Tienhoven<sup>4</sup> (1921) reported a case in which slight epigastric distress and a palpable tumor had been noted. Röntgenograms of the stomach did not reveal definite lesions, but strong peristaltic contractions were seen, as in stenosis. At operation a tumor of the duodenum, 6.5 cm. in diameter and weighing 148 gm., was removed; it had encroached on the lumen of the duodenum, producing partial stenosis. The tumor proved to be fibromyoma, springing apparently from the longitudinal muscle of the duodenum. Waugh<sup>5</sup> (1923) found a congenital cyst of the duodenum in a baby aged nineteen days. It was drained but recurred. The baby died from bronchopneumonia following a second operation. Willis and Lasersohn<sup>6</sup> (1925) noted two cases of benign duodenal tumor at opera-

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tion. The first patient was a man aged sixty-three, with a definite history of dull distress in the epigastrium, some nausea and vomiting with loss of appetite and a fifteen-pound loss of weight. Röntgenograms indicated a lesion at the pylorus without obstruction. A well-filled duodenal bulb could not be obtained. At operation a large polypoid pedunculated tumor was found attached to the posterior wall of the duodenum. This could be invaginated up through the pyloric sphincter. Histologic examination proved it to be adenoma, consisting of the structural elements of Brunner's glands. The second tumor was an adenoma of the duodenum about 2 cm. in diameter, which was found during the course of an operation for stone in the common-bile duct. The history of the case was of biliary colic with jaundice. Carman<sup>7</sup> (1921) and Camp<sup>8</sup> (1924) reported two cases of benign tumors of the duodenum. Vogt<sup>9</sup> (1925) reported a case of benign perforating duodenal cyst, but as it was regarded as having arisen from remains of the Wolffian body it has not been included in our list.

Three of the six patients observed at The Mayo Clinic were men and three were women; the ages ranged between twenty-two and fifty. Two of the tumors were myomas, two were adenomas, one was an adenomatous polyp, and one a hemangioma.

REPORT OF CASES.—CASE I.—A woman, aged thirty-six, had experienced recurring mild attacks of pain in the right iliac fossa and a sense of discomfort in that region between attacks. For six months she had noticed indefinite soreness and burning in the upper right side of the abdomen, which usually lasted only a few minutes and was not associated with meals. She was troubled somewhat with belching.

All clinical examinations were essentially negative. Röntgenograms of the stomach were not made. A diagnosis of chronic appendicitis was made and exploration advised. At operation January 17, 1914, a small ulcer was found on the anterior and superior wall of the duodenum, 1.25 cm. below the pylorus. Immediately below this was an irregular, flattened nodule which measured approximately 1 by 2 cm. The nodule was excised and on microscopic examination proved to be adenoma of Brunner's glands. The appendix was removed secondarily. Convalescence was satisfactory, and ten years later the patient reported that she had been free from gastro-intestinal distress since the operation.

CASE II.—An unmarried woman, aged forty-two, gave a history of having had indefinite stomach trouble all her life. Myomectomy for fibromyoma had been performed. Three years before examination she had had a severe gastric hæmorrhage followed at varying intervals by seven others. The last, which had occurred four weeks previously, had been preceded for some time by epigastric pain coming on two or three hours after meals. A blood transfusion had been given the following day.

The general examination was negative. The hæmoglobin was 43 per cent., erythrocytes numbered 3,260,000, leucocytes 6,200 and platelets 246,000. The bleeding time was two minutes and coagulation time (Boggs) eight minutes. The chemical constituents of the blood were normal. The röntgenologist reported duodenal ulcer. Exploration, December 11, 1925, revealed an ulcer on the anterior wall of the duodenum about 1.25 cm. below the pylorus. About 5 cm. below the pylorus was a tumor approximately 2.5 cm. in diameter, involving the anterior wall of the duodenum. The tumor was excised and the opening closed with chromic catgut and silk. The ulcer, with the cap of the duodenum and the anterior part of the pyloric sphincter muscle, was also excised and the opening closed as a gastroduodenostomy.

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The pathologist found a linear ulcer (2 cm. by 1 mm.) of the duodenum practically healed and myoma of the duodenum with an ulcerated area on its mucous surface 12 mm. in diameter. Because of the rather large area of ulceration on the myoma and the fact that the duodenal ulcer was apparently healed, it is probable that the tumor was the cause of the previous hæmorrhages. It is possible, however, that the ulcer may have healed following the hæmorrhage four weeks previously. Eleven months later the patient reported that she had gained weight, strength, and color, but occasionally experienced slight distress after eating.

CASE III.—For the last six years a man aged thirty-seven had had periodic attacks of dull gnawing pain in the epigastrium, coming on two or three hours after meals and relieved by food. The attacks lasted several weeks with intervals of from two to six months. The last attack had begun eight weeks before admittance. The pain had been especially distressing for two days (five weeks before examination) when the patient suddenly felt sick and vomited "two quarts" of dark bloody fluid. Since that time he had been on a restricted diet with definite relief.

The patient was twenty-seven pounds under his usual weight. Except for some tenderness in the epigastrium and pyorrhœa, the general examination was essentially negative. The hæmoglobin was 73 per cent., erythrocytes numbered 4,650,000 and leucocytes 7,600. The total gastric acidity was 62 and the free hydrochloric acid 44. Röntgenograms of the stomach and duodenum were negative; those of the teeth showed periapical infection graded 2. A clinical diagnosis of bleeding peptic ulcer was made and exploration advised. At operation March 5, 1927, there was no evidence of ulceration in the duodenum or stomach, but palpation of the duodenum revealed some thickening along its inferior border. An incision made just above this area did not show a break in the mucosa but a definite tumefaction about 1 cm. in diameter which could be picked up with the fingers. This was excised. The appendix was somewhat thickened and was removed. The spleen was of normal size but was slightly adherent to the diaphragmatic surface. Exploration of the gall-bladder, liver, and pancreas was negative.

The pathologist reported adenoma of the duodenum. The immediate convalescence was uneventful and further hæmorrhage has not been reported. The relationship between the duodenal adenoma and the hæmorrhage is, of course, problematic. The spleen must be considered as a possible factor, although splenomegaly was not present. The infection around the teeth may have produced hæmorrhagic erosions in the stomach.

CASE IV.\*—A man, aged forty, two years after being partly buried in a gravel pit, noticed that his stools were sometimes dark and tarry. He had dull pain in the epigastrium from one to two hours after meals with some bloating and belching. Eight months previously he had had a severe hæmorrhage and passed numerous large tarry stools. A similar hæmorrhage had occurred two weeks before examination.

The hæmoglobin was 63 per cent., the total gastric acids were 56, and the free hydrochloric acid was 40. Röntgenograms revealed deformity and filling defect of the duodenum suggestive of a papillomatous growth. At operation August 20, 1923, a markedly congested tumor was found in the duodenum. Partial duodenectomy and gastrectomy were carried out, with closure of the duodenal stump and anterior end-to-side gastrojejunostomy following the resection.

Pathologic specimens showed myoma 4 by 3.5 by 3 cm. and an ulcer 1.5 cm. on the mucous surface. In February, 1927, the patient reported that he had remained well.

CASE V.†—A woman, aged twenty-two, had had symptoms of chronic dyspepsia since childhood. During the eighteen months previous to examination two acute attacks of indigestion lasting two days had occurred. Slight nausea and frontal headache followed by sour emesis with relief had also occurred.

\* Previously reported by Camp.

† Previously reported by Carman.

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Röntgenograms of the stomach were negative. The duodenum was shadowed as a ring with a translucent centre suggesting a polypoid growth. At operation May 6, 1921, the gall-bladder was normal. Appendicitis was graded 1 and the appendix was removed. The stomach was somewhat thick-walled and dilated. The pylorus was wide open. Just below the pylorus and completely filling the duodenum was a tumor 7 by 5 cm. attached by a sessile base on the duodenal side of the pylorus. Transduodenal excision was made.

The pathologist reported hemangioma. A report on the patient's condition since dismissal has not been received.

CASE VI.—A man, aged fifty, had had a massive gastric hæmorrhage four weeks previously.

Examination disclosed splenomegaly, which was thought to be secondary to cirrhosis of the liver. The total gastric acidity was 20; free hydrochloric acid was not present. Röntgen-ray examination showed duodenal ulcer. At operation February 13, 1923, nodular cirrhosis of the liver was found. The pyloric veins were large, about 1.5 cm. in diameter. Palpation of the duodenum revealed a round pedunculated tumor within the lumen. This was removed and proved to be an adenomatous polyp 0.5 cm. in diameter. The patient recovered satisfactorily but returned a year later because of several severe hæmorrhages from the stomach. Although the splenomegaly suggested possible blood dyscrasia from this source, a diagnosis of hepatic cirrhosis with probable hæmorrhage from œsophageal varices was made.

### TABULATION.

#### *Summary of Data.*

CASE I.—Age 36, female. Symptoms—Burning and soreness in upper right side of abdomen not related to meals; belching; mild attacks of pain in right iliac fossa; duration six months. Clinical and laboratory data—Clinical examination essentially negative. Operative data—1-17-14; irregular, flattened nodule, 1.2 cm. by 1.8 cm. on anterior superior wall of duodenum 1.2 cm. below pylorus; small ulcer immediately above it. Operation—Nodule and ulcer excised; appendectomy. Pathologic report—Ulcer on adenoma of Brunner's glands. Comment—No gastro-intestinal distress ten years later.

CASE II.—Age 42, female. Symptoms—Eight gastric hæmorrhages (some of them severe); the last one four weeks before examination was preceded by epigastric pain two or three hours after meals; duration three months.\* Clinical and laboratory data—Hæmoglobin 43 per cent.; erythrocytes 3,260,000; leucocytes 6,200; platelets, 246,000. Röntgenologic data—Duodenal ulcer. Operative data—2-11-25; ulcer on anterior wall of duodenum 1.2 cm. below pylorus; tumor 2.5 cm. in diameter, 10 cm. below pylorus. Operation—Excision of ulcer; excision of tumor. Pathologic report—Practically healed linear ulcer 2 cm. by 1 mm.; myoma 3 by 2 cm. with 12 mm. of ulceration on mucous surface. Comment—Reported gaining weight and strength eleven months later, color better, occasionally slight distress after eating, one slight hæmorrhage.

CASE III.—Age 37, male. Symptoms—Periodic attacks of dull pain in epigastrium two to three hours after meals relieved by food, last attack five weeks before examination; vomited 1,892 c.c. of bloody fluid; duration six months. Clinical and laboratory data—Hæmoglobin 73 per cent.; erythrocytes, 4,650,000; leucocytes, 7,600; total acidity 62; free hydrochloric acid 44. Röntgenologic data—Stomach and duodenum normal; dental infection. Operative data—3-5-27; "definite tumefaction" about 1 cm. in diameter in duodenum; no break in mucosa; further exploration of abdomen negative. Operation—Excision of tumor of duodenum; appendectomy. Pathologic report—Adenoma. Comment—Immediate convalescence uneventful, not heard from after going home.

CASE IV.—Age 40, male. Symptoms—Tarry stools at times; dull pain in epi-

\* Transfusion.



gastrium two hours after meals with belching; two severe hæmorrhages eight and a half months before examination; duration two months. Clinical and laboratory data—Hæmoglobin 63 per cent.; leucocytes 5,900; total acidity 56; free hydrochloric acid 40. Röntgenologic data—Filling defect in duodenum suggestive of papillomatous growth. Operative data—8-20-23; congested tumor 2.5 cm. in diameter in duodenum. Operation—Pylorectomy (Balfour-polya). Pathologic report—Myoma 4 by 3.5 by 3 cm., with ulcer 1.5 cm. on mucous surface. Comment—Had remained well four years later.

CASE V.—Age 22, female. Symptoms—Some chronic dyspepsia, nausea, vomiting and headaches since childhood; in last eighteen months two acute attacks of crampy pain in upper part of abdomen with vomiting, lasting two days; duration one and a half months. Clinical and laboratory data—Hæmoglobin 65 per cent.; erythrocytes 3,920,000; leucocytes 7,300; total acidity 36; free hydrochloric acid 22. Röntgenologic data—Stomach normal, duodenum shadowed as ring with a translucent centre suggesting polypoid growth. Operative data—5-6-21; tumor 7 by 5 cm. filling duodenum, attached by a sessile base on duodenal side of pylorus. Operation—Excision of tumor. Pathologic report—Hemangioma. Comment—No report from patient six years later.

CASE VI.—Age 50, male. Symptoms—Some indigestion all of life; alcoholism; massive gastric hæmorrhage four weeks previously; duration four weeks. Clinical and laboratory data—Hæmoglobin 63 per cent.; erythrocytes 3,720,000; leucocytes 3,200; total acidity 20; no free hydrochloric acid; splenomegaly thought secondary to hepatic cirrhosis. Röntgenologic data—Duodenal ulcer. Operative data—2-13-23; cirrhosis of liver, pyloric veins about 3 mm. in diameter; pedunculated tumor in duodenum. Operation—Excision of tumor. Pathologic report—Adenomatous polyp 0.5 cm. in diameter. Comment—Reexamined one year later; several severe gastric hæmorrhages; cirrhosis of liver with œsophageal varices.

## COMMENT

In all but one of the six cases symptoms seem to have been accounted for by the presence of the tumor. The most significant sign was hæmorrhage, which was severe in four of the six cases. In one of these, however, the hæmorrhage was afterward proved to have been due to other causes.

In five of the six cases some form of indigestion was present. In three of these it had simulated somewhat the ulcer type. In one a small duodenal ulcer may have produced the symptoms. In one not associated with ulcer sufficient time has not elapsed since operation to determine the significance of the tumor in the production of the symptoms. A tumor was not noted on examination in any case. In only one case also was definite obstruction present. This is in sharp contrast to benign tumors elsewhere in the small bowel which usually first attract attention by producing intussusception. The tumor was ulcerated in three of the seven cases; in two of these hæmorrhages were severe.

A diagnosis of benign tumors of the duodenum can be made only by the Röntgen-ray. Unless the tumors are large, however, it is difficult to visualize them on account of the rapid passage of the medium through the small bowel. Two of the tumors in the series were diagnosed as such by the Röntgen-ray. While gross gastric hæmorrhage or melena should suggest the possibility of benign duodenal tumor, other intragastric and duodenal lesions which may have produced it are so much more common that this is indeed a remote possibility. So far as we have determined, an instance of such a tumor having undergone malignant degeneration has not been reported.

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## DUODENAL DIVERTICULA AND THEIR SURGICAL TREATMENT

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FROM THE LOCKWOOD CLINIC

A COMPREHENSIVE search of the literature by Baldwin,<sup>3</sup> Buschi,<sup>4</sup> Wilkie,<sup>25</sup> Fischer,<sup>10</sup> and other writers shows that prior to the year 1912 the known number of cases of duodenal diverticula did not exceed one hundred.

Case,<sup>6</sup> of Battle Creek, was probably the first to diagnose the condition by X-ray examination, and in 1913 reported four cases at the Scientific Exhibit of the American Medical Association. In 1920 he reviewed the literature to that date, reporting a series of eighty-five cases. He also described his X-ray technic of diagnosis and reported a number of operative results.

Following the X-ray recognition of the condition a great many cases were reported, including a large series in England by Spriggs and Marxer,<sup>22</sup> Cole,<sup>8</sup> Larimore and Graham,<sup>15</sup> Cryderman,<sup>9</sup> and others, as well as many in foreign literature.

Grant<sup>12</sup> in 1922-1923 reported the occurrence of duodenal diverticula to be 16.2 per cent. in thirty-seven cases examined. He used the cadaver in the dissecting room and demonstrated the diverticula through the method of injecting paraffin into the duodenum. Baldwin, in a series of 105 cases, was able to demonstrate the condition in 13.3 per cent.

Linsmayer<sup>16</sup> found the condition in 3 per cent. of 1367 necropsies as did Rosenthal<sup>20</sup> in a series of one hundred cases.

By X-ray examination Case found duodenal diverticula in 1.2 per cent. of all cases having complete gastro-intestinal examination by means of barium, and McMillan reported 1.5 per cent. in his series. Andrews<sup>1</sup> likewise reported 1.2 per cent. In my own series the condition has been recognized in a little over 1 per cent. of cases examined. These figures indicate that the condition is not recognized nearly as frequently as it should be.

There has been a great deal of discussion as to whether the condition is congenital or acquired, and much evidence has been advanced to support both views. As the embryological development of the duodenum is very complex one would expect this portion of the intestinal tract to be prone to developmental defects, and duodenal diverticula has been recorded a number of times in necropsies of infants. The X-ray recognition of the condition has been confined to adults—Spriggs and Marxer have watched small diverticula, under repeated examination, over varying intervals of time, grow from the size of a pea to that of a walnut. They are satisfied from their observations that by X-ray examination they have recognized in the colon a pre-diverticula stage consisting of local inflammatory areas which, if untreated, give rise to diverticulitis. The condition is almost always recognized in patients past middle life and quite conceivably occurs in areas weakened

## DUODENAL DIVERTICULA

Fig. 1.—Diverticulum of the second part of the duodenum from the inner border.



Fig. 2.—Diverticulum of the first part proximal to a duodenal ulcer.



by local inflammation as a result of local strain and stress to which the part may have been subjected. Careful consideration of the subject seems to indicate that the condition may be either congenital or acquired.

There is as yet no symptom complex by which a duodenal diverticulum may be diagnosed without recourse to X-ray examination. In all patients complaining of obscure upper abdominal symptoms the condition should be kept constantly in mind. Many of the cases recorded have suffered for years from distress and pain, and not a few have been operated for some other condition before their lesion was diagnosed. Many cases of acute



FIG. 3.—Diverticulum of the second part of the duodenum from the outer border.

diverticulitis have been reported, the condition having been recognized when operation was undertaken for acute cholecystitis or perforating ulcer. Perforation of the diverticulum according to Monserrat,<sup>18</sup> and as demonstrated in one of the cases herewith reported, occurred prior to operation. Hemorrhages have occurred in two of the series of cases reported by Spriggs and Marxer. Two of my own series gave a previous history of severe hemorrhage. In the cases reported by Spriggs and Marxer 47 per cent. produced symptoms which could not be explained by any other pathology.

A feeling of fulness or distension is a symptom frequently described. One of our patients in discussing her symptoms said she felt at times that something was about to burst in her epigastrium, though she did not suffer from distension or bloating. Aching and severe attacks of pain radiating through to the back and simulating biliary colic are common. Nausea and



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vomiting at intervals over a period of years, together with marked loss of weight, have been frequently noted. At times tenderness is found on palpation over the diverticulum, especially at the time of the X-ray examination. Smithies<sup>21</sup> says that he has observed no cases which presented a typical history of duodenal ulcer. Several of the cases reported herewith gave a classical history of duodenal ulcer and were so diagnosed by the clinician prior to X-ray examination.

Claremont and Schinz<sup>7</sup> report six cases, all producing symptoms, in five of which the diverticulum was the cause. Two of these were treated surgically. Butler and M. Ritvo<sup>8</sup> report four cases, two of which were operated, one being entirely relieved of symptoms. No follow-up record of the other case was found.

In cases reported by Moore,<sup>19</sup> Forsell and Key,<sup>11</sup> and Basch<sup>2</sup> operative removal of the diverticulum resulted in apparent cure of symptoms.

Larimore and Graham have reported a number of cases of duodenal diverticula which were associated with cholecystitis; cholecystectomy relieved the symptoms. Case reported cases in which cholecystectomy or gastro-enterostomy relieved the symptoms, as well as cases in which the diverticulum was removed resulting in cure.

Hartung<sup>13</sup> reported a case in which the patient was explored by the surgeon and the diverticulum not being found, appendectomy was performed. The symptoms persisted and subsequent X-ray examination again demonstrated the presence of a diverticulum. He also reported five cases which improved on medical treatment. Spriggs and Marxer reported many of their cases as being improved on medical management.

Sir Harold Stile<sup>22</sup> removed a duodenal diverticulum two and one-half inches long, resulting in relief of symptoms. Maclean reported a series of sixteen cases, four of which were operated, three with entire success. The last case was operated too recently to report end results. In two of his cases peri-diverticulitis was marked at operation and in one peri-duodenitis was the outstanding feature. He gives a full description of the operative technic employed for the exposure of the diverticulum and his method of dealing with the sac, having been unable to find any technic so far described in any book on operative surgery.

Thompson<sup>24</sup> in 1926 reported the only case we have found of diverticulum of the stomach. The case was explored for gastric pain and vomiting and an adhesion from the cardia to the pylorus was cut, nothing else being found to account for the symptoms. As the patient did not improve he was again X-rayed and the diverticulum recognized on the posterior wall, an inch below and internal to the cardiac orifice. This was dealt with at a second operation and the patient was cured of his symptoms.



FIG. 4.—Diverticulum of the second part of the duodenum from the inner border.

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Kenard and Vandel<sup>14</sup> reported a case with a history extending over fifteen years, characterized by severe pain and loss of weight; surgical interference brought relief and gain of eight pounds in weight.

REPORT OF CASES

CASE I.—A. T., male, aged sixty-three years, blacksmith, weight 175 pounds. Came under observation in April, 1926. The patient gave a twenty-year history of stitch-like pain in the epigastrium, chiefly under the left costal arch. The distress at the onset was of short duration, half to one hour, becoming gradually progressive until the attacks would last two to three days. For the past eight to ten years the distress was almost constant, and at times the pain was severe, but did not simulate gall-stone colic.

There was no food relationship, but if the patient ate meat he would often vomit it. Bowels regular.

Physical examination was negative except for left inguinal hernia. Test meal: total acidity 35; free hydrochloride 30. X-ray showed stomach and duodenal bulb normal. Large diverticulum second portion duodenum.

At operation the surgeon could not locate the diverticulum, although he mobilized the entire first and second portion of the duodenum, encountering fairly free hemorrhage from some of the mesenteric blood vessels. There was an area of thickness and induration extending into the head of the pancreas, but it could not be clearly defined



FIG. 5.—Diverticulum. (Same as Fig. 4.)

as the diverticulum without a great deal more dissection than was thought advisable and as there was a cholecystitis, grade II; cholecystectomy was performed. Further experience has convinced us that if dealing with a similar case and the diverticulum could not be readily exposed, we would at once incise the duodenum in the area where the radiologist had localized the diverticulum, and having found the stoma with a finger in the sac as a guide, dissect it free from its surroundings.

When this patient left the hospital, X-ray demonstrated the diverticulum as before. The patient was seen one year later, still complaining of epigastric distress with excessive gas formation and bloating, necessitating that he loosen his clothing. He also suffered from an occasional vomiting spell. It has been learned that this patient has a private still and alcoholic gastritis may, and probably does, account for much of his distress.

CASE II.—R. S., male, aged twenty-eight years, came to the Lockwood Clinic in September, 1927. For several years the patient had suffered from spells of gastric distress lasting a few days, followed by similar intervals free from pain. The condition had become practically chronic during the past year, the distress coming on several hours after meals and being definitely relieved by food and alkalies. There was excessive gas formation with belching, but no bloating. Soreness had developed during the past year, radiating from the right costal margin to the back, but no history of acute colic was given.

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Physical examination was negative. Test meal: total acidity 81; free hydrochloride 70. Clinical diagnosis: duodenal ulcer. X-ray examination: duodenal ulcer with diverticulum of the first part of the duodenum.

Operative diagnosis: Sub-acute duodenal ulcer with diverticulum 3 x 2 cm. proximal to the ulcer, and chronic appendix.

Operation: Gastro-enterostomy and appendectomy, inversion and oversewing of the diverticulum.

The patient made a satisfactory recovery and has been relieved of his symptoms.

CASE III.—R. K., female, aged thirty-four, came for examination in September, 1927. She gave a history of abdominal distress and discomfort for the past twelve years with three or four attacks of "gastritis," each attack confining her to bed for about two weeks. Epigastric pain was a prominent symptom and mustard plaster was used over the abdomen for relief. Eating increased her distress. She had nausea but no vomiting during the attack. In 1918 she had been operated on elsewhere for chronic appendix and in 1920 right nephropexy was performed by the same surgeon.

Physical examination was negative. Clinical diagnosis: chronic nervous exhaustion, but because of previous spells of gastritis a test meal and stomach X-ray were advised. Test meal: total acidity 21; free hydrochloride 13. X-ray examination showed the stomach and duodenal bulb negative. There was a large diverticulum on the free border of the second portion of the duodenum. Operation was advised and carried out, the diverticulum being excised and the stump inverted. Gall-bladder normal. This patient had a stormy convalescence and when seen on several occasions at intervals of some months, while feeling better, was still complaining of gastric discomfort. In a recent letter answering a questionnaire, she says: "My appetite is good, I am feeling pretty well and gaining in weight."

CASE IV.—G. M., male, aged sixty-five years. Seen for the first time in November, 1927. He gave a history of attacks of epigastric distress for nine years, the first lasting six weeks. Blood was vomited once during this attack. The second attack, six years ago, lasted two weeks; and at this time the stools were black and tarry for several days. He had suffered a third attack six weeks previous to coming to the Clinic, during which epigastric soreness or distress came on two hours before meals and at times hunger pains at 2 A.M. No discomfort was experienced while adhering strictly to a light diet and masticating his food well. Between spells there was entire freedom from symptoms.

Physical examination was negative. Clinical diagnosis: duodenal ulcer—gall bladder. Test meal: total acidity 61; free hydrochloride 48. X-ray examination: stomach and duodenal bulb negative, large diverticulum second part of duodenum.



FIG. 6.—Loculated diverticulum of the second portion of the duodenum.

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The patient was put on Sippy diet, and remained on this three months free from distress, but losing weight. He then began to eat more liberally and developed severe epigastric pain, associated with bloating. Vomiting was induced for relief afforded—very tender over epigastrium. Three attacks in ten days, requiring morphia and codeine to control the pain. Hæmoglobin had dropped from 89 per cent. to 64 per cent. and the red blood count to 3,100,000.

Operation February 29, 1928. The surgeon reported: 1. Chronic cholecystitis with cholelithiasis. 2. Acute inflammatory lesion, second portion of duodenum, perforating into the head of the pancreas and well walled off with adhesions. It was impossible to undertake any dissection of the duodenum itself because of the sub-acute nature of the adhesions at the site of perforation. 3. Chronic appendix.

Cholecystectomy, appendectomy and post-gastro-enterostomy were performed. This patient when last seen was entirely free of symptoms.

CASE V.—J. C., male, aged sixty-three years, came to the Lockwood Clinic November 23, 1927. His chief complaint was stomach trouble from which he had suffered for the past two months, never having had any previous distress. The patient complained of a hungry feeling associated with pain two hours after meals, and was occasionally wakened at night. The distress was eased by food and alkalis.



FIG. 7.—Large diverticulum of the first part proximal to a duodenal ulcer.

Physical examination was negative. Clinical diagnosis: duodenal ulcer. Test meal: total acidity 38; free hydrochloride 48. X-ray examination: stomach and duodenal bulb negative. Diverticulum second portion of the duodenum.

The case was treated medically and up to the present time the patient has been relatively free from symptoms while adhering to a strict diet.

CASE VI.—A. E., female, aged forty, came to the Clinic in January, 1928. She gave a history of nineteen years of abdominal distress and pain mostly in the epigastrium. Nineteen years previously she had been operated upon for chronic appendicitis. Thirteen years ago, when four months pregnant, she had a post-gastro-enterostomy for clinical diagnosis of duodenal ulcer. Four years ago internal shortening of round ligaments.

Her chief complaint at the time of her examination was of a constant, aching pain under the ribs on the right side, radiating through to the shoulder, often with a feeling as if something were going to burst in the epigastrium. Belching of gas +++; bloating ++; could obtain no history suggestive of duodenal ulcer at any time. Had been X-rayed twice recently and been told that there was no evidence of any duodenal ulcer and that it was doubtful if she had had a gastro-enterostomy, as there was no evidence of a stoma. The clinician who examined the patient made a provisional diagnosis of cholecystitis.

Test meal: total acidity 36; free hydrochloride 23. X-ray examination showed a gastro-enterostomy opening very high on the posterior wall of the stomach. The

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duodenal bulb filled well and there was no evidence of ulcer. Large diverticulum of second part of duodenum.

The patient was put on medical management for three months, but as her symptoms did not respond to treatment, operation was advised and carried out in April.

A large diverticulum of the second portion of the duodenum projecting into the pancreas was dissected out, cut off, and the opening in the duodenum closed with two rows of chromic catgut.

As there was no evidence of any ulcer in the bulb, the gastro-enterostomy was cut off and the gall-bladder removed because of a low grade cholecystitis.

I interviewed this patient recently and she said her operation had been well worth while. She was entirely relieved from her gastric distress and was free from the sensation of something about to burst in her epigastrium. She was eating well and gaining in weight.

CASE VII.—J., male, aged sixty-eight, came to the Clinic in February, 1928. He gave a history of stomach trouble for forty years, recurring in spells of two to four weeks' duration with long intervals of freedom. The attack began with a sense of distress or discomfort—no pain—always on an empty stomach, and was relieved by food and alkalis. He had frequent night pain. During the past six years he vomited often, with increasing frequency during the past two years, usually on lying down at night. Occasional retention vomit. Bloating ++. Tarry stools?



FIG. 8.—Diverticulum of the third part of the duodenum from the inner surface.

Physical examination was negative except for grade II enlargement of the prostate. Clinical diagnosis: duodenal ulcer with obstruction. Test meal: total acidity 52; free hydrochloride 40. X-ray examination: No. II retention of barium meal and duodenal ulcer with diverticulum proximal to the ulcer.

The surgeon's findings corroborated the clinical diagnosis and a post-gastro-enterostomy was done, no attempt being made to do anything to the diverticulum.

The patient made an uneventful recovery and at the time of his dismissal was free from symptoms. However, on the first of July last his home doctor wrote us that he was again poorly—that he had upper abdominal distress and vomited large quantities of bile. I wrote this patient about the end of August, and he said that on returning home he had developed an ischio-rectal abscess and was very miserable until this cleared up. At the time of writing he was feeling fine, had no gastric distress and was eating well.

CASE VIII.—W. N., male, aged fifty-eight years, admitted July 12, 1928. The patient gave a clinical history of periodic spells of epigastric distress for twenty years past, beginning with a sense of fulness and discomfort with some regurgitation, and later, about 1912, developing attacks of severe pain. In 1921 he suffered from free gastric hemorrhages, vomiting large quantities of bright red blood and passing tarry stools for some days. He was confined to bed for two months and kept on a diet of egg and milk



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for one year. The feeling of moderate fulness and discomfort continued from then until two months before his admission to the Clinic, at which time he had developed severe pain in the mid-epigastrium, radiating through to the back, on one occasion requiring morphine to control the pain. So distressing was his sense of fulness at night that he could only sleep in a sitting position and often lay on his stomach on a hot water bottle for relief. Former X-ray diagnosis of duodenal ulcer.

Physical examination showed moderate epigastric tenderness. Diagnosis: 1. Duodenal ulcer of perforating type. 2. Cholecystitis. Test meal: Total acidity 75; free

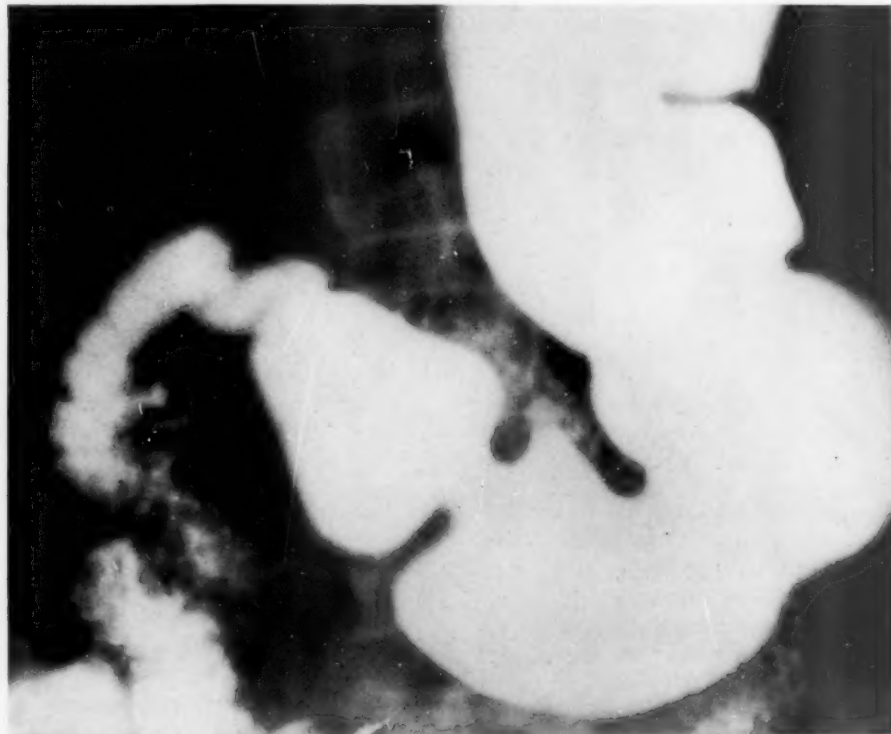


FIG. 9.—A small diverticulum of the second part.

hydrochloride 65. X-ray examination: stomach and bulb negative. Large diverticulum of the third portion of the duodenum.

Operation: Cholecystectomy and appendectomy performed, the surgeon reporting grade III cholecystitis with definite evidence of previous trouble in the appendix.

The duodenum was explored for the diverticulum but as it could not readily be exposed in view of pathology already found, it was not considered advisable to undertake the dissection necessary to locate it. Later experience has taught us that the best approach to a diverticulum located in this area is secured as suggested by Maclean by retracting the colon upward and making an incision through the meso-colon in an endeavor to locate the diverticulum by blunt dissection.

An interesting point in this patient's history was the fact that he could not sleep lying down, but could do so in a sitting posture, this being the position best suited for gravity drainage of the sac of the diverticulum.

CASE IX.—G. A. B., female, aged fifty-one years, seen for the first time June 22, 1928. According to the history given by the patient she had, about 1919, developed an acute attack of severe pain in the right upper quadrant. The pain and tenderness lasted

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one day. Appendectomy and cholecystectomy were performed in 1920. The patient felt better for from three to six months. She was then operated for post-operative hernia. Since then she had had more or less chronic epigastric distress, with spells when distress and pain were more marked. Pain radiated through from under the right costal margin to the right shoulder. Distress and soreness were more marked two to three hours after meals, and about 4 A.M. Alkalies gave some relief, but food did not seem to give relief.

Physical examination was negative except for tenderness in right upper quadrant. Diagnosis: duodenal ulcer and chronic cholecystitis. Test meal: total acidity 86; free



FIG. 10.—Large diverticulum of the second and also of the third portion of the duodenum.

hydrochloride 68. X-ray examination: gall-bladder—Graham-Cole technic—negative. X-ray of stomach: duodenal ulcer with moderate sized diverticulum of second part on inner border.

Sippy management tried for one month with slight improvement.

Cholecystectomy and post-gastro-enterostomy were performed July 19th. No endeavor made to find the diverticulum.

CASE X.—H. T., female, aged seventy-eight years, seen for the first time in June, 1928. She gave a history of stomach trouble off and on for twenty years with attacks of one to two weeks' duration until about three years ago. Distress since then was more or less chronic. Pain came on one hour after meals and was definitely relieved by food. Vomiting ++ had occurred about two weeks previous to admission.

Physical examination showed moderate tenderness over the epigastrium. Clinical diagnosis: duodenal ulcer. Test meal: total acidity 60; free hydrochloride 38. X-ray examination showed No. I gastric retention and large diverticula of second and also of the third portion.

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This patient was kept on ulcer diet and alkalis for about two months, with only slight relief from symptoms. Finally she asked to be operated on as she felt that something must be done to obtain relief. At operation a large diverticulum of the second part dissecting into the head of the pancreas was readily located by opening the duodenum and with the finger in the diverticulum, it was a comparatively easy matter to free it prior to excision. The large diverticulum of the third part was approached by retracting the colon upward, incising its mesentery and by a little blunt dissection locating the sac. These diverticula were both very large, being quite as big as an average hen egg. While it is early yet to judge of end results, the patient has had a remarkably easy convalescence and is very grateful for the relief she has experienced.

### SUMMARY

Diverticula of the œsophagus, colon, Meckel's diverticula and bladder diverticula have for years been operated successfully for relief of distressing symptoms. Duodenal diverticula do not seem to have received the same surgical recognition which the severity of the symptoms noted seem to warrant. Large diverticula often show evidences of retention of barium from twenty-four hours to six or seven days. They are always discovered on routine X-ray examination, usually under the fluoroscope in adult patients, presenting themselves because of upper abdominal distress from which they seek relief. The condition should be constantly kept in mind when no other diagnosis can be made to account for the patient's symptoms as evidence would seem to show that it occurs much more frequently than is generally realized. When recognized by X-ray, medical management may at times be tried with marked relief if the symptoms are not urgent.

Cholecystectomy, gastro-enterostomy or excision of the diverticulum have all been performed by different surgeons with apparent cure. The method employed in a given case must depend on conditions found at the operating table combined with the judgment of the surgeon and his skill in dealing with the difficult surgical problems of the upper abdomen. In our cases the best results have followed excision of the diverticulum.

The difficulty experienced by the surgeon in locating diverticula at operation calls for accurate localization on the part of the radiologist. The majority of duodenal diverticula occur in the second portion. They practically always occur through the posterior wall where it is not covered by peritoneum, this increasing the difficulty in locating them at operation.

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## AFFECTIONS OF THE APPENDIX IN YOUNG CHILDREN \*

A REVIEW OF 100 CASES.

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AFFECTIONS of the vermiform appendix in infants and the younger group of children is taken up for consideration because most authors have emphasized the following points: (1) the immunity of nurselings to appendicular disease, (2) its relative rarity in early life, (3) the difficulty of diagnosis, owing to the insidious onset and the obscure clinical picture; (4) the tendency to early perforation, with rapid spread of inflammation and overwhelming toxemia; and (5) the high mortality in the first half decade of life.

Many isolated case reports refute the statement that nurselings are immune to appendicitis. It has even been found in the first week of life on several occasions. Its rarity in early life has been too greatly emphasized. While relatively rare, it is by no means uncommon under five years of age, as increasing evidence goes to prove.

The diagnosis of appendicitis may be and often is a difficult problem at any age, but it is peculiarly so in infants and very young children. The emphasis placed on the rarity of this disease is such that in subjects under two years of age it is often not even thought of, and is overlooked altogether in all but the worst of cases. Another reason why it is sometimes unrecognized is because of failure to make a systematic and thorough physical examination. Even when one is on the alert there are certain instances where the picture is so baffling and the examination so puzzling or misleading or negative that a diagnosis is delayed or not made at all. Naturally, the younger the patient the more difficult is the diagnosis. Fortunately, however, in the majority of cases, and especially so as age increases, the clinical picture is just as clear-cut and characteristic and as easy to interpret and the physical examination as satisfactory as in adults.

Certain anatomical anomalies and variations help to explain why appendicitis is such a serious disease in early childhood. The cecum may not have rotated or descended normally. The appendix itself is relatively much larger, longer, more funnel-shaped, contains a larger proportion of lymphoid tissue and is much more delicate in structure. Its position is less constant, usually being located above McBurney's point. It may be found anywhere in the abdomen,—in the pelvis, under the liver or well over on the left side. Occasionally it may be held fixed by a vestigial band or fold, or it may be retroceally placed and completely buried. When perforation of an inflamed appendix occurs, the delicate omentum, often veil-like in thinness, offers but a feeble barrier to the spread of inflammation. Knowing these anatomical

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differences, it is easy to understand why appendicitis is much more insidious in onset, the spread of inflammation more rapid, the intoxication more overpowering,—in short, it is not difficult to see why the disease is so serious in the very young. On the other hand it is not reasonable to conclude that the tendency to perforation, abscess formation or spreading peritonitis is the rule at this period. It is far more probable that the majority of cases, undiagnosed it is true, go on to spontaneous recovery. Many cases of indigestion-colic, gastritis, gastro-enteritis, acidosis, cyclic vomiting, etc., and many acute infections, accompanied by abdominal symptoms (pain, vomiting, fever, etc.) are in reality instances of unrecognized appendicular disease. In every attack of acute abdominal pain it is a safe rule to assume that the appendix may be involved and then proceed to verify or rule out this suspicion. The habit of deciding that such disorders are due to dietary indiscretions and that a purgative will relieve the indigestion-colic is responsible for many deaths.

The mortality in acute appendicitis in early life is extremely high. All observers are in accord on this point. In nurselings it is over 70 per cent. In eighty cases under two years of age collected from the literature by Abt, the mortality was 50 per cent. Under six years the mortality is variously estimated as from 15 to 40 per cent. Such a death rate is too high! It means failure to recognize the disease early, or delay in instituting surgical treatment, or gross mismanagement in administering purgatives, when the diagnosis is in doubt. Purgation and procrastination are responsible for the majority of deaths.

In statistical reviews on the subject of appendicitis in children the age limit is usually placed at from twelve to fourteen years. For convenience the patients can be arranged into two groups,—the first embracing all patients up to and including the sixth year, and the second group including all the older children. This paper will be limited to a discussion of the younger group. Generally speaking, older children present fewer problems in diagnosis and show a morbidity and mortality rate which compares favorably with that of adolescents. In fact, in the experience of the writer his results have been more generally favorable at this than at any other period of life.

A series of 100 cases, personally operated upon by the writer, supplies the data for such impressions and comments as are embodied in this paper. In the majority of instances the findings at operation and the laboratory reports were in accord. Occasionally, the clinical symptoms and the macroscopic anatomical picture did not agree with the laboratory findings and diagnosis. No case has been included in this review, however, in which the laboratory gave a normal or negative report.

The age incidence in the series is of interest: under twelve months, eight cases, all associated with acute intussusception; from one to two years, five cases; from two to three years, ten cases; from three to four years, nine cases; from four to five years, eighteen cases; from five to six years, twenty-three cases; and in the sixth year, twenty-seven cases. Males were affected in seventy-one and females in twenty-nine instances. Seventy-five per cent.

of the cases were diagnosed as acute or subacute appendicitis and 25 per cent. were of the chronic variety. The former ranged from mild acute catarrhal appendicitis to the very worst types of gangrenous appendicitis, with abscess, or more or less widespread peritonitis. The chronic cases, for the most part, gave histories, which suggested previous mild acute attacks of appendicitis: fourteen were associated with hernia, one with acute intussusception, one with tonsillitis, three with tuberculous mesenteric lymphadenitis, and two with pin-worm infestation of the appendix.

There were six deaths among the 100 patients operated upon, giving a mortality of 6 per cent. There were no deaths in twenty-three cases ranging in age from four months up to two and seven-twelfths years of age. There were two deaths between three and four years, two deaths between four and five years, and two deaths between five and six years. Contrary to popular teaching, young subjects show remarkable resistance in combating appendicitis. There is practically no mortality in early and properly handled cases, and the mortality is far less than one would expect in the late and obviously mismanaged ones.

*Intussusception and Appendicitis.*—For some years appendectomy has been advocated when operating for acute intussusception in children. This was due to a belief that a causative relationship existed between appendicitis or appendicular irritation and acute intussusception in a certain proportion of cases. In our early experience the condition of the appendix was noted, but no pathological study was made of this organ. In more recent years, however, all such appendices have been sent to the laboratory for pathological examination, and it is interesting to note how often the specimens show definite evidence of disease. When the appendix is caught in the invagination, trauma unquestionably influences the pathological picture. But when the appendix is not actually involved in the invagination process, and is in no way traumatized, how then can the frequent association between acute intussusception and an inflamed appendix be explained? It is the conviction of the writer that appendicitis is one of the common causes of intussusception.

*Hernia and Appendicitis.*—In examining children with right inguinal hernia, the presence of a thickened tender appendix in the hernial sac was detected in several instances. On two occasions, at operation, the diseased appendix was found adherent in the sac and irreducible. Every surgeon at some time or other has probably encountered acute appendicitis associated with right inguinal hernia. The history and physical examination in hernia patients will frequently suggest appendicular disease, and one can often prophesy beforehand and verify at operation this suspicion. Many times has a parent brought a child for operation on account of the discomfort supposed to be caused by a rupture, when in reality the distress was occasioned by a diseased appendix. In a child appendicitis should always be suspected when a hernia gives subjective symptoms of any kind. So frequently are hernia and appendicitis associated that this combination can hardly be dismissed on

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the grounds of coincidence. It is the exception to find a normal appendix in a child who has had a hernia, unsupported by a truss, for any considerable period of time. The longer the hernia has existed the more probable it is that a complicating appendicitis is present.

*Chronic Appendicitis.*—The statement often made that chronic appendicitis is a non-existent condition or a very rare lesion in early life is not borne out in a study of this series of cases. Twenty-five cases were classed as "chronic," "healed" or "healed purulent" appendicitis. Recurring attacks of abdominal pain, usually of short duration, with nausea, with or without vomiting, and with slight fever, are the chief characteristics of the clinical picture.

TABLE I—*Fatal Cases*

Age	Sex	Time sick before operation	Additional diagnosis	Time bet. operation and death	Apparent cause of death
3 years	M.	5 days	Multiple abscess and general suppurative peritonitis	4 days	Paralytic ileus and sepsis
3½ years	M.	5 days	Abscess	14 days	Fecal fistula, sepsis and exhaustion
4 years	M.	3 days	General suppurative peritonitis	13 hours	Sepsis
4 years	F.	10 days	Rupture of localized abscess with general peritonitis	3 days	Sepsis
5 years	F.	?	Spreading peritonitis	7 days	Sepsis
5-9/12 years	M.	4 days	General suppurative peritonitis	5 days	Sepsis

Point or localized tenderness, in the absence of abdominal sensitiveness elsewhere, is an important objective sign. The surgeon is warranted in doing an exploratory operation, if, after a thorough study of the case, including an X-ray examination of the gastro-intestinal and genito-urinary tracts, other conditions which might be confused with appendicitis can be eliminated.

The symptomatology, diagnosis and details of the surgical treatment of acute appendicitis will not be taken up in this article. It may not be amiss, however, again to mention that in the differential diagnosis it is of the utmost importance to exclude pleural, pulmonary and even meningeal inflammations. A circumscribed or central pneumonia or a diaphragmatic pleurisy, without physical signs, may be mistaken for appendicitis. The minutest attention to details is necessary in order to avoid errors. Other medical conditions which

## EDWARD W. PETERSON

may cause confusion or doubt are (1) gastro-enteritis, (2) acute right-sided pyelitis and (3) occasionally Henoch's purpura. Among the surgical conditions to be borne in mind are (1) intussusception and other types of intestinal obstruction, (2) mesenteric lymphadenitis, (3) peritonitis not due to appendicitis, (4) inflamed or adherent Meckel's diverticulum, (5) stone or inflammation, affecting the right kidney or ureter, (6) pelvic disease in females (salpingitis, or inflammation or growth of the right ovary), (7) inflamed or twisted right undescended testicle, (8) duodenal ulcer, (9) psoas abscess, (10) infections of the right hip-joint, etc. Appendicitis, too, may complicate or be associated with tonsillitis, influenza, pneumonia, measles,

TABLE II  
*Intussusception and Appendicitis.*

Chart No.	Name	Sex	Age	Diagnosis	Result
26323	Rosario R.	M.	4 mos.	(1) Intussusception, acute (2) Appendicitis, acute	Recovery
35003	Louis V.	M.	4 mos.	(1) Intussusception, acute (2) Appendicitis, gangrenous	Recovery
14033	Christine A.	F.	7 mos.	(1) Intussusception, acute (2) Appendicitis, acute, and acute peri-appendicitis.	Recovery
34810	Joyce P.	F.	7 mos.	(1) Intussusception, acute (2) Appendicitis, subacute pur- ulent and purulent peri- appendicitis.	Recovery
5967	Bernard S.	M.	8 mos.	(1) Intussusception, acute (2) Acute congestion of appen- dix and chronic peri-appen- dicitis.	Recovery
21658	Harry K.	M.	8 mos.	(1) Intussusception, acute (2) Appendicitis, chronic, with congestion and swelling of mucosa, and hyperplasia of lymph follicles.	Recovery
5389	Seymour K.	M.	8 mos.	(1) Intussusception, acute (2) Appendicitis, acute	Recovery
13519	Gerald S.	M.	10½ mos.	(1) Intussusception, acute (2) Appendicitis, subacute	Recovery
7558	Max W.	M.	17 mos.	(1) Intussusception, acute (2) Appendicitis, acute	Recovery
—	Helen R.	F.	4-1/6 yrs.	(1) Appendicitis, acute (2) Intussusception, acute, en- teric.	Recovery

typhoid fever, and the various affections before mentioned. One should never be satisfied with a single diagnosis of tonsillitis or measles or what-not in the presence of pronounced abdominal symptoms, otherwise appendicitis is going to be overlooked occasionally.

Table I gives the important details in connection with the six cases which terminated fatally.

## AFFECTIONS OF THE APPENDIX IN YOUNG CHILDREN

### CONCLUSIONS

- (1) Appendicitis in early life is on the increase.
- (2) Early recognition and prompt surgical treatment of appendicitis give almost uniformly good results, even in infants and the younger group of children.
- (3) Delay in the recognition of the disease, or in instituting surgical treatment, accounts for the high mortality and the distressing morbidity in young subjects. Purgation and procrastination are responsible for most of the bad results.
- (4) There appears to be a definite relationship between appendicitis and acute intussusception, and between hernia and appendicitis.



## MALIGNANCIES OF THE COLON\*

BY JOHN F. ERDMANN, M.D.

AND

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IN 1922, in the *New York Medical Journal and Record*, in association with Dr. R. F. Carter, I reported 129 cases of malignancy of the colon coming under my operative observation in a period of six years preceding the report.

At this time I am reporting an additional 186 operated cases from January, 1921, to January, 1928, a period of seven years. Out of the first series of 129 there were fifteen inoperable, while out of this series of 186 but eleven were recorded as exploration only, showing one of two facts: either that we were obtaining our cases earlier, or we considered and found the operability better as we were becoming more adept and more proficient in our judgment. I am privately inclined to the latter view. Patients whom I would not have accepted earlier in my career, I am operating lately with a very fair outlook.

Malignancies of the large intestines far exceed that of the stomach, while the small intestine has been found with a malignancy in but one instance by me in over five years. This one instance occurred in the past year: the site of the growth just distal to the ligament of Tritz. The sites of the growth in this series vary slightly from those reported in the recorded 129 cases.

Taking the two series together, the frequency record as to position is 103 rectum and recto-sigmoid, 105 sigmoid proper, fifty-one cæcum and ascending colon, thirty-five terminal transverse colon, splenic and descending colon, twenty-one terminal ascending colon, hepatic and proximal transverse colon.

The age and sex of these patients were rather equally divided in patients with the growth above the sigmoid. A marked difference in sex preponderance occurs in females in the lowest segment, the recto-anal. In the sigmoid, in a series observed, there were ten more males than females, while in the recto-sigmoid and the recto-anal there were ten more females than males. The average in the 129 observations was forty-nine years, the youngest a female of twenty-two, the oldest a female of eighty-nine.

The rapidity of growth in these patients is influenced as is cancer in other parts of the body; *i.e.*, by the age of the patient and the type of cell. The structures invaded primarily are mucous membrane, musculature, etc. The more youthful the patient the more rapid the growth. The lapse of time

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\* Read before the New York Surgical Society, October 24, 1928.

## MALIGNANCIES OF THE COLON

between the initial onset of the growth and the time of operation cannot be estimated, as all calculations must be based upon and reckoned from the appearance of the first symptoms, either subjective or objective; and unfortunately, often the first symptom is objective, such as blood or mucus in the stool. Multiple growths have not been encountered in this series, neither was there one in the series reported in 1922, although I have seen multiple growths in cases considered in earlier contributions.

An interesting instance occurred in the series reported in 1922 that may be considered a multiple growth, or again may be classed as a remote-appearing secondary growth. This patient had had a typical Friedreich operation by me for a cæcal and appendicular carcinoma three years before, followed in two and one-third years by a growth in the sigmoid. It may well be speculated that this patient had the sigmoid growth at the time of resecting the cæcum, etc., or that he had a metastasis (unusual) in the sigmoid from the growth removed. This patient had had an exploratory appendix operation done one year before I saw him, and his appendix, for some unknown reason, was not removed.

From the viewpoint of regional classifications, the symptoms should vary somewhat, but in the main they are prone to slight variation. It is a well-observed fact that in growths involving the cæcum and ileo-cæcal regions obstruction is a rarity, due to the liquid state of the contents of the small bowel. No acute ileus was observed in any of the patients in this series, but in several instances definite cramp colics were located in the right lower quadrant, showing in these patients upon operation a very small opening at the ileo-cæcal valve, due to growth invasion almost closing the valve opening. There is an ever-present anæmia in these patients, characterized by a very profound state in the majority of cæcal and ascending colonics, gradual improvement in hæmoglobin as the growth is found toward the recto-sigmoid; in other words, the higher (more proximal) in the colon the growth is, the more profound the anæmia will show.

Palpation evidence in the cæcal and ascending colonic growths is apt to be late, as is also X-ray evidence, while in the sigmoid zone X-ray is prone to show earlier evidence. This is due to the presence of annular growths in the sigmoid as compared to lateral or mural growths in the cæcum, also to the calibre of the gut in these areas, as well as to the musculature structure.

Some of these patients complain of a feeling of soreness and distress with pressure at the site of the cæcum and appendix, particularly so when the growth becomes obstructive. On various occasions I have operated for these growths when the patients have been previously operated for a so-called chronic appendix. I plead guilty to the same operative error on two occasions. Our error is easily explained, recalling that an obstruction, either partial or complete, exists distal to the cæcum, that the small intestine is pouring fluid contents into the cæcum with the by-product of gas due to fermentation, etc., and that the egress is obstructed. The resulting dilatation of the cæcum, appendix and upper colon becomes a source of pain or distress,

and unless great care is observed by the eye and palpating fingers, the true source of the symptom is overlooked.

My first offense, about twenty-five years ago, was in a young man of thirty-four with a colloid carcinoma of the transverse colon. I removed the appendix (for pain in the right lower quadrant) that contained foreign bodies, was eight inches long and one-half inch in diameter in the greater portion of its length; cæcum not dilated enough to call attention to the importance of further search; followed in ten days by total obstruction, which I thought at this time to be an ordinary surgical complicating sequence, as obstruction by adhesions, bands, etc. Upon opening the abdomen the growth was found in the mid-transverse colon. Recovery followed proper repair, the patient living eleven years, and dying of a large growth of the right shoulder, X-rayed as an osteo-sarcoma, no biopsy or autopsy being done.

The second of my own was in a patient who bled from his bowel about six weeks after his discharge from the hospital for an appendectomy. X-ray on this patient before operation was reported negative. Subsequent to his bleeding, X-ray reported growth in the splenic flexure.

I am not inclined to lay great stress on alternating diarrhœa and constipation, as by the time these occur the diagnosis by other and earlier symptoms should have been made.

Colic in the cæcal area is in evidence whenever the growth is sufficiently occlusive to obstruct free flow through the ileo-cæcal valve, or through the caput into the colon. As the disease progresses, when located in the distal colon, cramp and colics are in evidence in the direct relationship to the amount of obstruction in existence. This symptom is essentially not due only to the invasion of the gut but to the consistency of the contents. The contents becoming more and more firm, as the terminal colon is reached it is quite evident that the mass becomes more obstructive, and that a calibre in the upper colon would transmit much that, due to absorption of fluids as it migrates to the distal colon, would readily obstruct the same calibre in the distal colon. It is therefore safe to state that the more liquid the colon content the less appearance of colics; and the reverse, that the more solid the moving mass the more evidence of colics and the earlier the obstruction.

Early toxemias are more often seen in obstructions of the proximal portion of the large bowel than in the distal half, easily explained by bacterial growth and absorption of toxins by the small intestines, and by the cæcal sewer trap one sees in practically all of this type. Borborygmus may be present or absent; if present, it is likely to be of a metallic, hissing sound like that due to gas or fluid passing through a small calibre. In obstruction, partial or complete, I have called attention for years to a metallic tinkle heard with the ear over the cæcal region when the opposite side is sharply pushed towards the median line. This sound is due to the collection of fluid contents in the cæcum with gas above it. I consider this sign an infallible one. In the post-operative obstructions one hears this same sign, also in the small intestines, and it is just as infallible. The conveyance of the heart sound in ordinary obstruction is not as a rule so evident in these cases unless the obstruction is of long duration. When this sign

## MALIGNANCIES OF THE COLON

(the metallic tinkle) is evident, operation should not be delayed. Fortunately for all, obstruction of the large intestine is never accompanied by the profound and grave toxic manifestations seen in obstruction of the smaller intestines.

The pains observed in these patients, excluding those of colics and spasms, in the sciatic, the lower back perineum, etc., are due to nerve involvements and pressure upon contiguous bones by growths involving the lower sigmoid, the recto-sigmoid and the recto-anal.

Pains in the lower back, sense of unfinished defecation, tenesmus, all demand an examination for growth in the lower sigmoid and rectum. It is rare to have these in high sigmoid involvement. Blood and mucus in the stools, frequent trips to the toilet, loss of ambition, loss of weight, pallor, etc., are added symptoms and signs of great weight. In the sphincteric area and just above it we may have a sphincter failure, due to infiltration of the muscle preventing the action.

The occurrence of perforation is not to be underrated, but when there is a sharp pain in the left lower quadrant without emaciation, without anæmia, no history of bloody or mucus stools, a patient robust, squattily built and about forty-five to fifty-five, diverticulitis should demand the first attention. I have seen about ten perforations in the 315 cases, all being found in sigmoid growths. Three were in the 129 series and the balance in the added 186.

*Aids in Diagnosis.*—Aids in diagnosis that are of inestimable value are the proctoscope and the X-ray. No patient who has pain in the lower back, perineal or sciatic distribution, who complains of distressing flatulence, tenesmus, or blood or mucus in the stool, should be allowed to leave the physician's observation before proctoscopic examination is made. No patient with abdominal colics, a sense of distress at any of the colonic flexures or throughout its course, nor in the event of a slow losing of weight, with or without evidence in the feces, should be dismissed from observation until a careful series of X-ray plates is taken. These should be taken both from a barium or bismuth intake by mouth and by enema. When one suspects a malignancy or other variety of obstruction impending, it is advisable to take the X-ray first by means of enema. On two occasions recently we have seen acute obstruction instituted by the intake by mouth, due to the mass forming, rocklike in character of the barium, causing a plug at the contracted lumen, necessitating thereby an emergency operation.

I am disinclined to give radium and X-ray any consideration except in the positively inoperable variety, as my experience with these agents is not pleasing in these growths.

Surgery, as early as one can, will give as good results in the colon as elsewhere. Late surgery is an alleviating agent in the majority. As previously stated, in the 315 patients but twenty-six were rejected as inoperable in some way or other: *i.e.*, even no artificial opening was advisable.

*Pre-operative Treatment.*—Thorough intestinal cleaning should be done when possible by cathartics, intestinal antiseptics and colonic irrigations;

when not possible, and this type is in the majority, an artificial opening should be made, thorough cleansing by irrigations for a week or ten days before the radical operation is done.

The artificial anus site is a matter of choice to the operator, but for years my selection has been the cæcum in preference to the other segments of the colon, because in all growths distal to the cæcum this position of the artificial anus is remote from the field of the final operation and does not interfere by newly-formed adhesions nor by soiling; and, finally, it is easy to close after its function has been terminated. The cleansing of the distal bowel through a cecostomy is readily performed by irrigation after the cecostomy is old enough—two to four days—to prevent leakage into the peritoneal cavity. It is gratifying to observe with what facility the rectal tube can be introduced into the colon through the cecostomy wound during the period of irrigation. A reverse peristalsis takes place readily during this period. During the time of the functioning artificial anus and before the radical operation is performed, careful attention must be given to renal functioning and nutrition. When possible, a Paul's tube is used for the first few days, such a procedure prevents the profuse liquid soiling that occurs in the early days if a Paul's tube is not used; an irrigation may then be carried out before the patient leaves the operating table.

*Radical Procedures.*—Under the heading of radical procedure one must consider the formation of a permanent artificial anus and the removal of the growth, with repair of the divided ends of the gut. Artificial anus as a temporary expedient has already been discussed, but as a permanent objective several important pathological features must be considered. A permanent artificial anus is to be made only in those patients in whom we find the growth so firmly fixed to surrounding structures that removal would end disastrously, or in patients in whom the contiguous and remote metastases are so extensive as to predicate an early demise with or without operative procedure. In this latter type with remote metastases, as in the liver, I have been doing the radical resection with anastomosis because a permanent artificial anus does not cause the metastases to subside, and because patients with an artificial anus in this variety of pathology, living for a period of from a few months to the best part of from two to three years with all the disagreeable associations of an artificial anus, could have had all the discomforts allayed or abolished by an additional risk of a small percentage. I have been very pleased with the results in this type of operation during the past ten or twelve years.

In the permanent artificial anus patients two methods of procedure as to the growth are to be followed. In the first instance the growth is allowed to remain, while in the second the growth is removed with all the surrounding tissue. The growth is left in those cases in which we find the infiltration extending beyond the possibility of total removal. Therefore, rather than excise a mushroom activity, the distal segment, after the proper preparation, is dropped into the abdomen and the proximal end is sewed into the abdom-



## MALIGNANCIES OF THE COLON

inal wall; or as in the lower sigmoid growths, one may leave the double-barrelled anus so that radium may be applied directly from above and below through the upper and lower stomas of the bowel. In the event that the growth is removable (this applies, of course, to the lowest segment), the lower portion is liberated from the sacral groove; then a perineal approach is made to remove this portion, the whole segment with the growth being delivered through the perineal incision.

In the event of a non-removable growth in portions of the colon proximal to the sigmoidorectal zone, short circuiting by means of a colonic or ileal byway is in order. This prevents an early total obstruction or a series of periods of partial obstruction.

*Methods of Anastomosis.*—As to the question of the method of anastomosis, end-to-end, side-to-side, or end-to-side, by suture or mechanical appliance, one must judge his own capacity for the type he will select. The advance in ability to suture without leakage in the great majority of instances, the ability to do fairly rapid work, and the improved qualities of catgut now upon the market place the Murphy button in the discard.

I have been doing the majority of my anastomoses during the past few years by the end-to-end method, doing a plastic on the smaller calibre end to meet with the larger end, as in the Friedreich operation, except in those instances where the gut is friable from œdema. In these a side-to-side is as a rule successful. Nor do I fear the hypothetical pocketing in doing a side-to-side anastomosis, because I always make the opening extend to within one-half inch of the inverted ends. I have had no more leakages in my end-to-end anastomoses than in the side-to-side, or end-to-side. Of course, there are occasions where one feels that a few minutes saved by doing a side-to-side will be advantageous.

For the past few years I am inclined in the recto-sigmoid operations to the making of a permanent sigmoidostomy and either resecting the lower gut or turning in the lower stump after one of the many excellent methods in vogue. The Coffee, and allied operations, are readily performed with very satisfactory outlook.

The operation of Mikulicz is quite applicable to the growths from the cæcum to the lower sigmoid and, while its hospital time is longer by 25 per cent. to 33 per cent., the mortality is so much less that one should practice this type more in the sigmoid bowel than any other type of operation. End-to-end anastomosis is a safe procedure from the cæcum to the mid-transverse colon, leakage being less, but when one approaches that portion of the gut with a wide base to its mesentery attachments, either the side-to-side or the Mikulicz operation should be done. Side-to-side operations, or end-to-side, are rarely accompanied by pouching and retention if the anastomosis is so made that a pouch does not exist at the time of operation.

Operation on the lower segment is readily done through the perineum, with or without removal of the coccyx. One can readily pull down, by careful dissection, six to twelve inches and implant the cut end in the per-

ineum either in the fore or rear part. I am inclined to give this operation first place in all lower growths.

The absence of early secondaries, in the low rectal and anal types, is readily explained by the lymphatic distribution. I am also struck by the good control many of the patients have.

The extensive operation of Miles I cannot, at present, feel is called for, particularly after closely analyzing his immediate and remote mortality.

It is customary to have an artificial anus established for seven to fifteen days before doing the radical operation. This procedure is the cause of the disappearance of the toxemia existing at the time the patient first comes under observation and permits of cleansing the bowel to the site of the growth, thereby facilitating the resection and preventing infection, to a great degree. It also brings about the subsidence of the œdema often seen in the proximal portions, and the subsidence of the marked distention—thereby bringing about a more normal diameter of the proximal end for anastomosis with the distal end. Finally, it is a safety vent during the repair of the suture line of anastomosis by preventing distension with gas and feces, and by taking the weight of the column of feces from the site of anastomosis again prevents leakage to a great degree.

A very excellent device for anastomosis by the end-to-end method in the lower segment is the Balfour tube method, with invagination of the anastomosis ring; this tube acting as a byway for both gas and feces.

I am not strongly inclined to believe that a complete circle of peritoneum is necessary for prompt union, though admitting its usefulness in promoting repair, but believe that in anastomosing, say the sigmoidorectal zone or sigmoid, that the first essentials are the preservation of the muscular and mucous membrane circulation, the exclusion of all fat lobules, and the accurate approximation of the muscular and mucous coats.

Admitted that anastomosis in these zones is particularly prone to fecal fistula formation, then the most important step is the instituting of proper and competent drainage for a few days. In the anastomosis proximal to the sigmoidorectal zone, I prefer no drain except in the skin wound.

#### END RESULTS

1. Extension of life with no foul discomforts; in those patients with existing metastasis in the liver at the time of operation, from eight to twenty-four months or more.

2. In those in whom no appreciable metastases at remote zones are found, extension of life from months to years. In this series we have traced the greater number of patients and find that there are several of each variety living from one to twelve years.

A great deal of lowering of the mortality in the past years is due, I feel, to the preliminary drainage by means of an artificial opening, and the care observed in placing this opening remote from the field of expected removal. This latter prevents undue adhesion work and soiling of the area by handling

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of an artificial anus when made in or close to the segment of gut to be excised. A goodly portion of the high mortality has also been due to the desperate condition in which some of the patients came to us, as several died following the performance of an artificial anus even under local or gas anæsthesia. This increase in mortality was due to the toxemia from obstruction absorption.

### RADIUM AND X-RAY TREATMENT

I do not feel entitled to discuss this treatment, but have some very definite views as to their general inefficiency as a cure. The question of pre-operative "sickening" the cell growth in patients when the growth can be reached is one of weight, well worth considering, although so far, I cannot speak with the same fervor as do some of my confreres. Radium has its place at present in the treatment of growths in the rectum, but has again been rather disappointing to me in several instances of supposed cures, which relighted in from six to nine months with redoubled vigor, rapidly placing the patients beyond operative relief, while in the majority of patients its service has not only been negligible but, I am satisfied, deleterious.

## MORTALITY FOLLOWING COLOSTOMY FOR CARCINOMA OF THE LARGE BOWEL

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THE type of operative manœuvre used in accomplishing colostomy varies somewhat according to the personal inclination of the operator, but certain measures, proved essential by experience, establish the advantages of one or

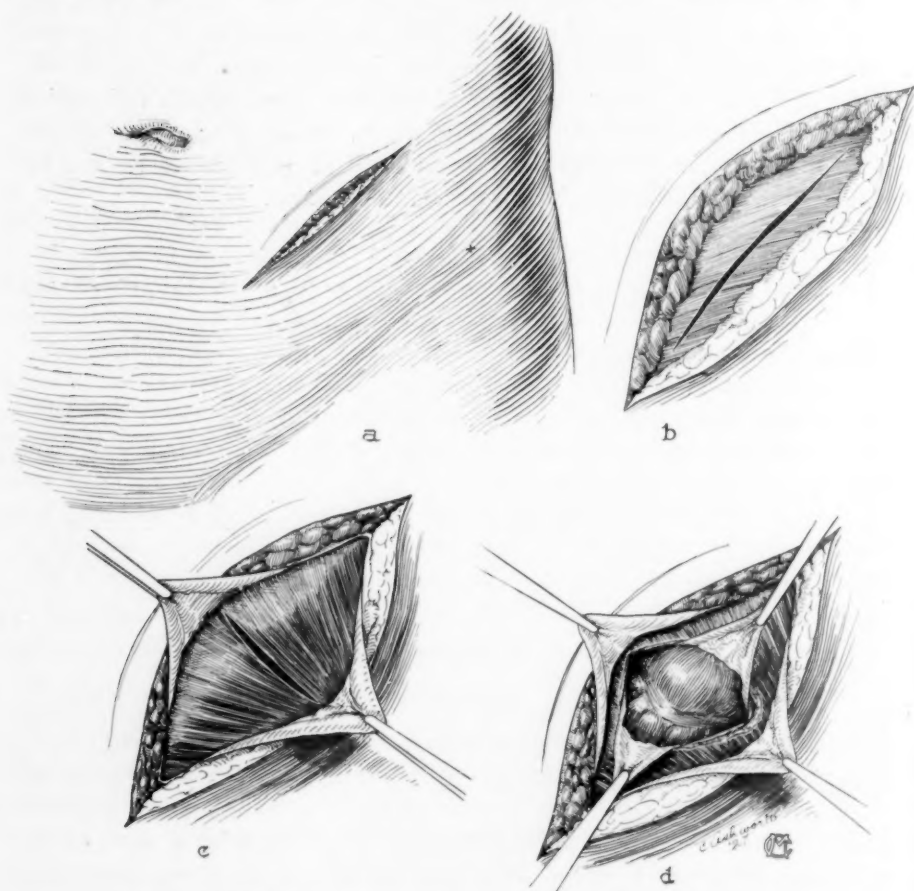


FIG. 1.—Split-muscle incision in the left lower quadrant of the abdomen, exposing the sigmoid. The incision bisects, at right angles, a line drawn from the umbilicus to the anterior-superior spine.<sup>1</sup>

two procedures. In performing colostomy, either as a palliative or first-stage procedure, it is fundamental that the liver, regional lymph-nodes, and neoplasm be thoroughly explored in order to determine the advisability of secondary operation. This may or may not necessitate an accessory incision,

## MORTALITY FOLLOWING COLOSTOMY

some operators preferring a low median-line incision when dealing with rectal and rectosigmoidal growths, exploring through it and using a smaller inguinal incision for the performance of the colostomy. I prefer to make a split-muscle incision well toward the anterior-superior spine of the ilium, through which adequate exploration may be carried out. The right rectus type of colostomy has its advocates and unquestionably is satisfactory in many instances, but it has two outstanding disadvantages. In most cases one will find herniation or at least weakness of the abdominal wall around the stoma, since closure around the bowel must of necessity be loose, and occasionally the loop of the colon may become an axis around which the small bowel revolves to become obstructed. A split-muscle incision and a Maydl type of colostomy, with certain modifications, approaches the ideal operation and, except when the mesentery of the descending colon or sigmoid is very short or absent, may be universally adopted. If the mesentery is not adequate, colostomy can be performed only in the transverse colon, a procedure which always necessitates a separate incision.

Sometimes there is controversy as to what portion of the bowel should be selected for permanent colostomy and while it is usually agreed that the sigmoid flexure is the most advantageous point, provided it has a long mesentery, occasionally the transverse colon is advocated. I have found that this portion of the bowel is not so satisfactorily employed and I avoid using it except in cases in which anatomic abnormalities render it necessary. Permanent colostomy in the transverse colon to precede resection leaves a long blind pouch of colon which fills up with fecal material despite the most enthusiastic measures for washing it out, and resulting discomfort is the rule rather than the exception. When the transverse colon is selected a mucous

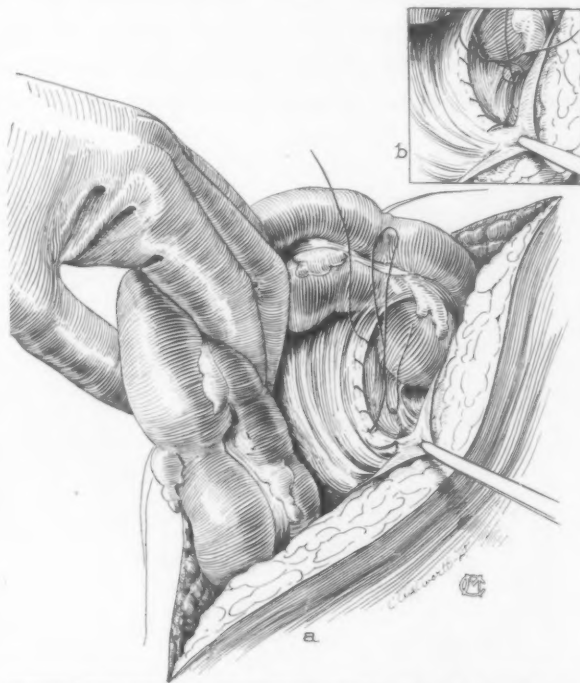


FIG. 2.—After exploration the sigmoid is "fed" back into the abdomen until its most fixed portion close to its juncture with the descending colon is reached. Here there is generally a fold of peritoneum running off from the lateral parietal peritoneum to the mesentery of the bowel. A purse-string suture placed around this obliterates the foramen laterally to the bowel and prevents obstruction from the loop of the small bowel slipping through it.



fistula in the posterior sacral region is desirable so that through-and-through irrigation may obviate the accretion of fecal material.

Three suggestions are of practical value in performing colostomy. First, the opening should be made as high as possible in the sigmoid or descending colon. By feeding the colon back into the abdomen as it is brought into the incision, one comes to a semi-fixed point where the bowel may be approximated in the wound yet not pinched tightly with the margins of the incision. This prevents herniation of the mucous membrane of the proximal loop months after the stoma has been cut through and the patient has become accustomed to it. Second, a section of skin, several centimetres wide, should

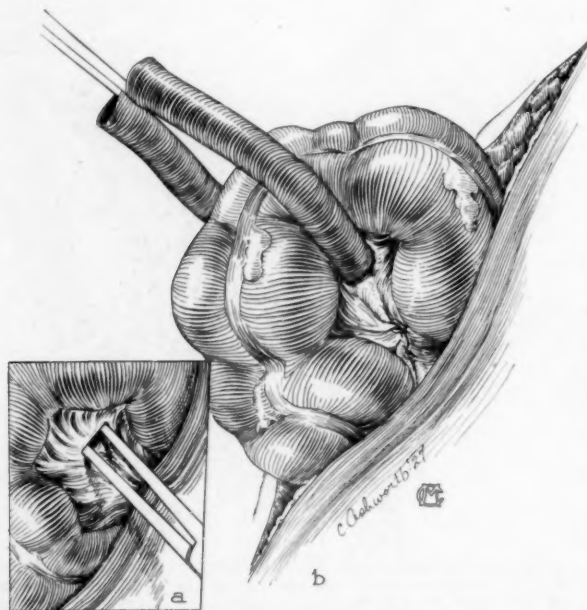


FIG. 3.—a, Hole made in mesosigmoid; b, rubber tube in place.

separate the two ends of bowel after it has been divided. This prevents the passage of fecal material into the distal loop as it may in the event that a blind pouch from 5 to 10 cm. long is left below after secondary resection. Third, the small space between the mesentery of the bowel and the lateral parietal peritoneum should be obliterated. As one pulls up the colon a peritoneal band extending from the lateral parietal peritoneum onto the mesentery of the sigmoid is usually found. If a purse-string suture is run around this band, including the parietal peritoneum as far as the anterior abdominal wall, and onto the mesentery, obliteration is accomplished and there is no danger that the small bowel will slip through the foramen and become obstructed. This has happened in an occasional case when this precaution was not observed. Except when the mesentery is heavy with fat and bleeding is difficult to control, or when the mesentery is extremely short, such a technical procedure is simple and easy. The abdominal wound is closed loosely around the bowel, only a few interrupted sutures being placed on the aponeurosis of the external oblique muscle. I believe it is important that the two layers of the abdominal wall, peritoneum and skin, be brought together and sutured under the bowel through a rent in the mesentery.

Fecal control following colostomy has been the object of ingenious procedures directed toward the manufacture of a sphincter muscle, which often result satisfactorily. The fact that practically any type of stoma may be

## MORTALITY FOLLOWING COLOSTOMY

attended to easily so long as the bowels are constipated, renders the results of colostomy satisfactory in the majority of cases. Control becomes partial in about three-fourths of the cases and by cleaning the stoma and irrigating it once or, at most, twice a day, habits are formed which soon lose their onerous nature. A technical manœuvre of C. H. Mayo's has been used in the Mayo Clinic for the last year with eminently satisfactory results, so far as control is concerned. He transplants a strip of the internal oblique and transversalis muscles around the upper loop of the bowel which is to be included in the colostomy, throwing this flap from below upward, leaving the piece attached to the outer side and bringing a similar skin flap from above

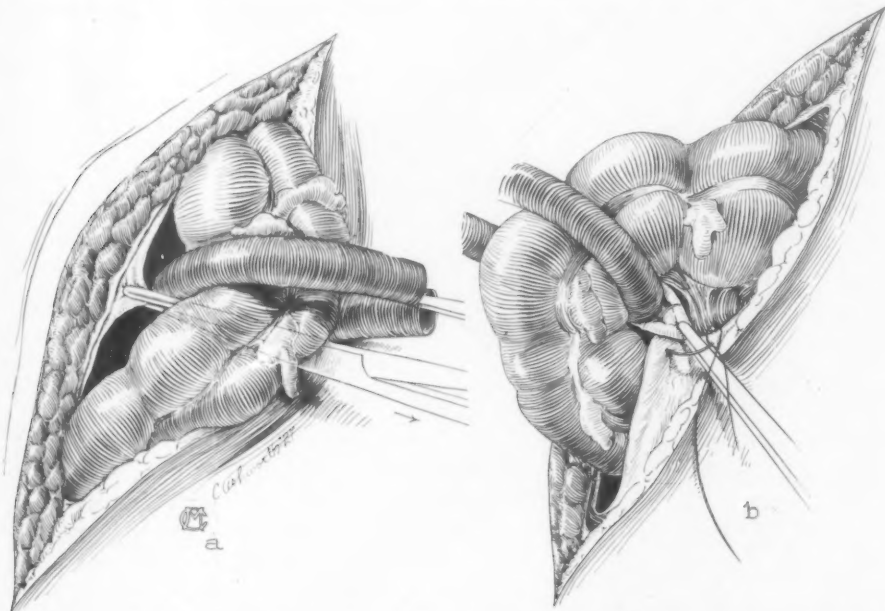


FIG. 4.—*a*, Peritoneum pulled under the sigmoid loop and sutured. With the exception of the skin, this is the only part of the abdominal wall necessary to pull under the colostomy. The opening in the mesentery is just in front of the purse-string suture which obliterates the lateral foramen. The peritoneum at the middle of the incision is pulled under the bowel. *b*, Skin pulled through and sutured in a similar manner to the peritoneum.

downward, which covers the bowel from behind, and over which slight pressure may be applied by a simple apparatus to prevent leakage of fæces.

Colostomy, whether performed preliminary to subsequent resection or as a palliative procedure for obstruction in cases of inoperable malignant growth is customarily not regarded as serious since the mortality rate is not excessively high. This is justified in cases in which the risk is not great because the colostomy is preliminary to resection. The death rate was not high in a large series of cases in which primary colostomy was performed for drainage followed by removal of the offending lesion. However, the mortality rate was high in a series of cases of carcinoma of the large bowel in which colostomy had been a palliative measure. Unfortunately in this group were a relatively large number of patients having malignant tumors of the colon who presented themselves for examination and treatment. In a few

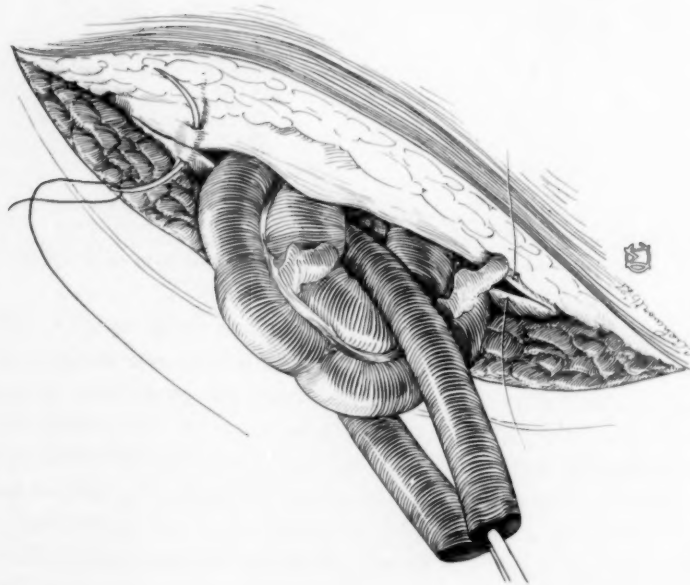


FIG. 5.—Closure of aponeurosis. It is unnecessary to close the muscles since the incision is a split-muscle.

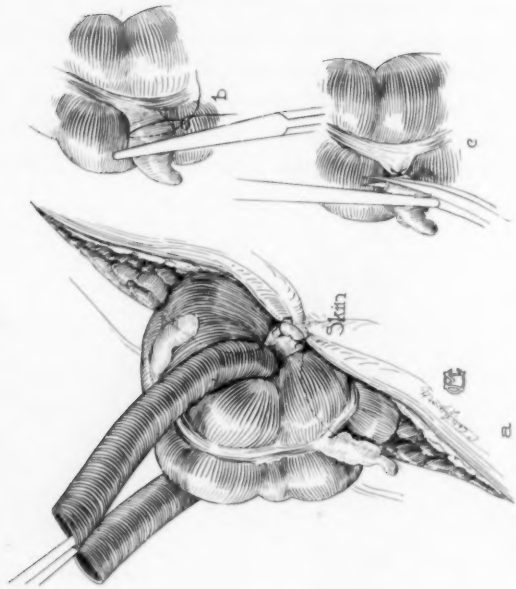


FIG. 6.—*a*, Completed operation. *b*, Removal of epiploic tags from the loop which is left out. The tags slough and should be removed as a part of the operation.

## MORTALITY FOLLOWING COLOSTOMY

cases faulty technic or an accident in the operating room might have been the cause of peritonitis but usually contamination from the growth itself, spread by the simple manipulation necessary to ascertain the degree of fixation and involvement of the lymphatics and operability was the underlying reason. The cause of death in the group of cases in which palliative resection was performed is not far to seek, since most of these patients appear for treatment in the latter stages of the disease when obstruction, desiccation and anemia have undermined their vitality, so that a slight infection may gain headway rapidly and terminate fatally. The performance of colostomy and exploration under such circumstances becomes hazardous. Obstruction must be relieved, and in many instances it is this unavoidable operation which increases the mortality rate in the entire group in which colostomy is performed.

Deaths and factors which cause death following colostomy should be classified according to the two main groups of cases in which this occurred: First, those in which colostomy was performed and in which the condition prohibited continuance of the operation, and, second, those in which resection was to follow colostomy

but death supervened before the second stage could be carried out. In order to arrive at some conclusions relative to the causal factors and percentage of mortality in a large series of cases, I have reviewed the records of 919 cases in which colostomy has been performed in the Mayo Clinic from 1920 to 1926, inclusive. Colostomy was performed in 385 cases in which further procedures were deemed impossible because of metastasis, extensive local involvement, or other factors which made it impossible to eradicate the malignant growth. In 584 cases, at exploration for colostomy, the growth was deemed resectable; however, in sixteen cases death occurred before the operation could be completed. From these figures it will be seen that a mortality of 7.67 per cent. attends the performance of colostomy as a pallia-

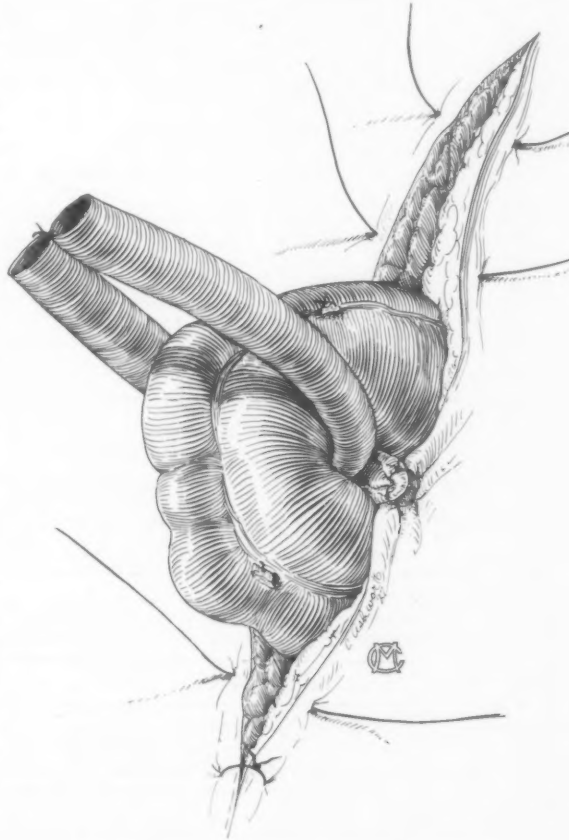


FIG. 7.—Closure of skin and completed operation.

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tive measure and 2.7 per cent. is the mortality rate of the operation in the group in which further operation is considered advisable.

In the first group of 335 there were 246 males who ranged in age from eighteen to seventy-seven years, the average being fifty-five years, and eighty-

TABLE I.

*Age and Sex Incidence by Decades in 335 Cases in Which Resection was Impossible Following Colostomy*

Age	Males	Per cent.	Females	Per cent.	Total.	Per cent.
10-19	2	0.81			2	0.59
20-29	7	2.84	6	6.75	13	3.88
30-39	15	6.09	9	10.11	24	7.16
40-49	43	17.48	21	23.60	64	19.10
50-59	72	29.26	32	35.95	104	31.04
60-69	84	34.14	14	15.73	98	29.25
70-79	23	9.34	7	7.86	30	8.95
Total....	246		89		335	

TABLE II.

*Conditions Prohibiting Resection Following Colostomy in Group of 335 Cases, with Number of Deaths in Hospital*

	Cases	Hospital mortality	Per cent.
Metastasis to liver.....	100	2	2
Fixed and extensive growth (obstruction in thirty).....	140	17	12.05
Acute obstruction.....	7	3	42.85
Attachment to bladder and peritoneum.....	21	2	9.52
Peritoneal and retroperitoneal involvement.....	17		
Pelvic metastasis.....	9	1	11.11
Involvement of bladder.....	8		
Involvement of prostate and bladder.....	6		
Attachment to prostate.....	3		
Metastasis to inguinal lymph nodes.....	7		
Metastasis to mesentery.....	4		
Multiple intestinal metastasis.....	6	1	16.66
Poor general condition (age, secondary anemia).....	6		
Epithelioma of larynx.....	1		
Total.....	335	26	7.76



# MORTALITY FOLLOWING COLOSTOMY

nine females, who ranged from twenty-two to seventy-three years, the average being fifty-four years. Table I shows the age of patients by decades. It is interesting to note that death in hospital occurs in certain groups of cases consistently and that fixation and obstruction are predominant factors in cases in which death supervenes. The various conditions contra-indicating

TABLE III.  
*Cause of Death in Twenty-Six Cases in Which Death Followed  
Palliative Colostomy*

Cause of death	Cases
General peritonitis.....	14
Bronchopneumonia.....	5
Acute diffuse nephritis.....	3
Pulmonary embolism.....	1
Edema of lungs.....	1
Perirectal and perirenal abscess with general sepsis.....	1
Cerebral hæmorrhage or embolus (?) and myocardial degeneration..	1

resection are tabulated in Table II. It will be noted that in 100 cases secondary resection was refused because of metastasis to the liver; however, this condition apparently did not increase the immediate mortality since only two of these patients died. Fixation and extension of the growth to adjacent vital structures rendered resection impossible in 140 cases; death occurred

TABLE IV.  
*Cause of Death in Sixteen Cases in Which Colostomy was Performed Pre-  
liminary to Resection*

Cause of death	Cases
General peritonitis.....	10
Pulmonary embolism.....	2
Bronchopneumonia.....	2
Pneumonia.....	1
Empyema.....	1

in seventeen of these. The highest mortality was associated with acute obstruction, nearly half of these patients dying following the primary operation. Peritoneal, vesical and prostatic involvement was common, but apparently did not add particularly to the operative mortality. Multiple intestinal metastasis occurred in six cases with death in one, and metastasis to the mesenteric and inguinal lymphatics was noted in eleven cases, in which there were no operative deaths. In only six cases was resection considered

inadvisable because of age, secondary anaemia, or general debility. The causes of death in the twenty-six cases which terminated fatally in the group in which palliative colostomy was performed are shown in Table III. Peritoneal contamination and pulmonary complications account for practically all, more than half being due to peritonitis. Pulmonary embolism was present in one case. Death followed colostomy in sixteen cases of the group deemed suitable for resection and the cause of death in these cases is given in Table IV. Peritonitis accounted for ten deaths, while pulmonary complications were responsible for the other six, pulmonary embolism being the cause of death in two cases. It is interesting to compare the mortality figures in the two groups from the standpoint of general resistance. Although the group for resection far outnumbered the group in which only palliative operation was performed, the mortality figures were reversed, two and a half times as many patients in the latter group dying after exploration and colostomy as in the former. Unquestionably the growths which cause obstruction and which are manipulated at exploration are the source of most peritoneal contaminations; for this reason the abdomen should be explored before the growth itself is handled. Further proof that the growth is the source of infection in many instances lies in the fact that in a graded operation on the colon or sigmoid, fatal peritonitis may result when there is no leakage at the line of anastomosis and resection at the second stage has been accomplished with perfect asepsis. The permeability of the wall of the bowel when there is obstruction is largely responsible for the increased likelihood of contamination. To obviate increased permeability and prepare patients more satisfactorily for any operative procedure on the colon, coöperative management, which includes pre-operative and post-operative care under group consultation, unquestionably is one of the most important adjuncts. The adequate cleansing of the bowel before operation, and the institution of the proper measures for rehabilitation of the patient before and after operation, have contributed materially to satisfactory end results.

## THE CARE OF THE COLOSTOMY

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FROM THE MEMORIAL HOSPITAL

A COLOSTOMY is always an inconvenience and when not given adequate attention it becomes a nuisance. The principal annoyance of the neglected colostomy is not only endured by the patient himself, but is extended to all persons with whom he may associate. However, despite certain adverse conditions associated with colostomies, they are essential, and at times imperative.

The foremost inconveniences of the colostomy have not been lessened, either by numerous attempts to construct an opening that could be voluntarily controlled by the patient, or by the mechanical appliances which have been invented for the same purpose. Nevertheless, the situation is not hopeless. There is a means of controlling these involuntary artificial ani, so that the patient may enjoy a comparatively comfortable life.

The colostomy bag, a popular appliance for involuntary control, is uncomfortable and difficult to keep clean and odorless. Although this apparatus provides for the collection of feces, it does not prevent contamination of the clothing by offensive odors; furthermore, constant wearing of these bags often produces a protrusion of the bowel and a weakening of the abdominal muscles.

Although an involuntary anus naturally requires more detailed care than the normal anus, nevertheless this fact is commonly disregarded. The most satisfactory condition is created by daily evacuation and lavage of the colon by means of a colonic irrigation. Clinical experience has proven that an irrigation of this nature prevents the expulsion of feces and escape of offensive odors for a period of twenty-four to forty-eight hours, thereby allowing the patient to carry on his ordinary routine as an inoffensive member of society. Usually the cleansing of the colon is completed in the morning (by the aid of tap-water, saline, or a weak solution of permanganate of

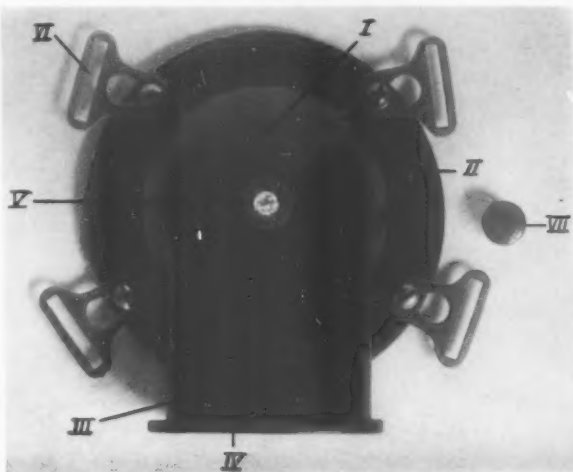


FIG. 1.—Exterior surface of cup. I—Convex surface of bowl of cup. II—Flat rim of cup. III—Outlet projection arm. IV—Shoulder on projection arm. V—Circular opening in centre of cup. VI—Belt clips attached to rim. VII—Threaded plug.

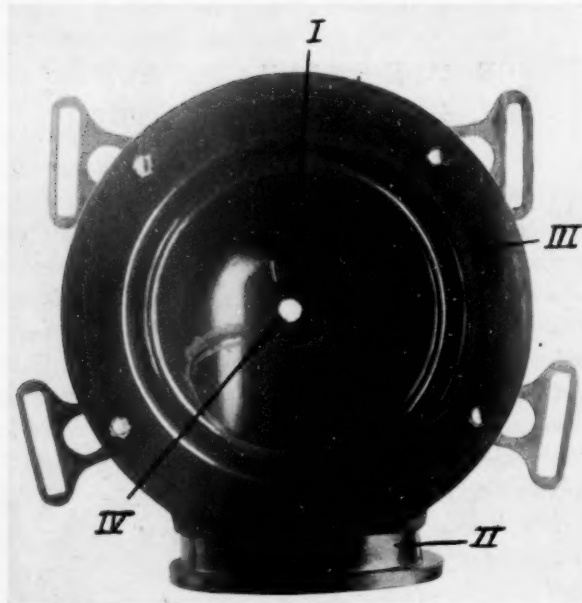


FIG. 2.—Interior surface of cup. I—Concavity of cup. II—Outlet of cup. III—Groove of rim. IV—Circular opening in centre of bowl.

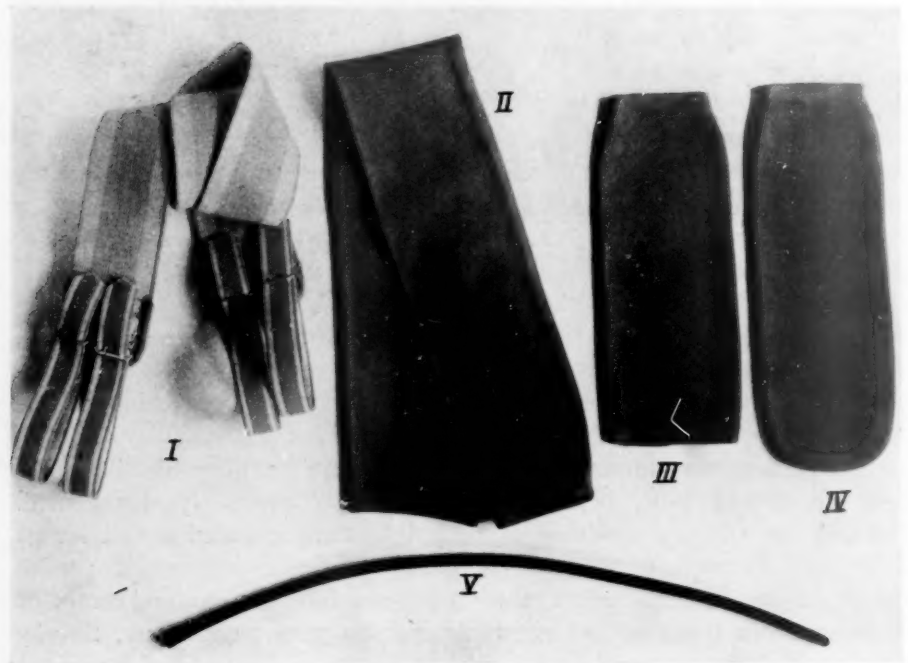


FIG. 3.—I—Canvas belt. II—Long rubber tube for bedridden patients. III—Short rubber tube for ambulatory patients. IV—Rubber bag for residual fluid. V—Small catheter.

## THE CARE OF THE COLOSTOMY

potash). A mild saline cathartic before breakfast is advantageous in producing a quick result with a constipated patient. Formerly the paraphernalia used consisted of the ordinary irrigating can, a few feet of rubber tubing, a stop-cock and a medium sized catheter. The latter was inserted into the colon for a distance of a few inches and the fluid allowed to flow until a feeling of fulness was produced. The flow was then stopped, and the catheter withdrawn, and the contents of the colon allowed to discharge into a receptacle. These steps were repeated until a copious evacuation and a thorough cleansing were obtained.

The results of this open method of irrigation were excellent. The operation itself, however, was frequently accompanied by unpleasantness and in

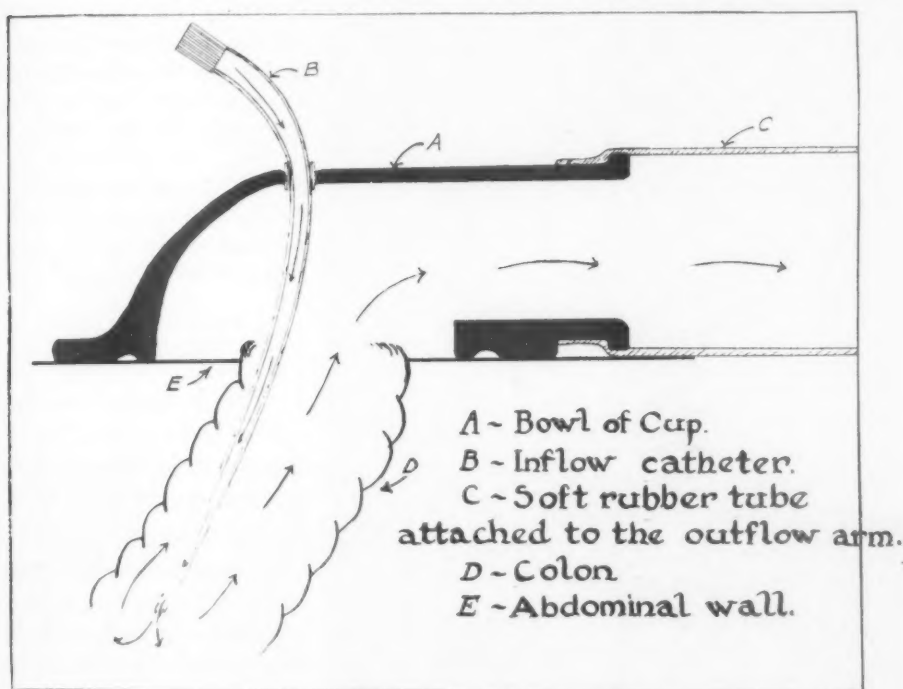


FIG. 4.—Cross-section drawing of cup in position.

many instances a certain amount of soiling could not be prevented. These difficulties were always enhanced when the patient had insufficient assistance and improper facilities. The difficulties and accompanying embarrassment of the above procedure suggested to the author the possibility of the closed irrigating apparatus which overcomes the main obstacles and makes fecal evacuation through a colostomy a simple and satisfactory procedure.

*The Colostomy Irrigator.*—The main apparatus which is composed of bakelite consists of a shallow cup or bowl with a wide rim. It is fashioned similarly to the cup of the Delatour colostomy bag. In the centre of the base of the bowl is a small circular opening through which passes a No. 20 French catheter for the inflow of the irrigating fluid. On one side of the bowl there is a large opening formed by direct extension of the bowl itself into a neck-like projection or extension, the outlet for the return fluid.



On the external surface of this extension, there is a projection shoulder which holds in place the soft rubber tube that conveys the fecal fluid from the cup to the receptacle or the toilet. The flat undersurface of the rim of the cup which rests against the skin has as its innermost margin a shallow groove to act as a seal and prevent leakage. On the outer surface of the rim are attached four belt clips to which in turn is attached an adjustable canvas belt, which holds the cup in position. By shifting these attachments, the direction of the outflow may be directed downward or laterally.

In addition to the bakelite cup the following accessories are included in the outfit: (1) an adjustable canvas belt; (2) a No. 20 French catheter; (3) an irrigating can; (4)

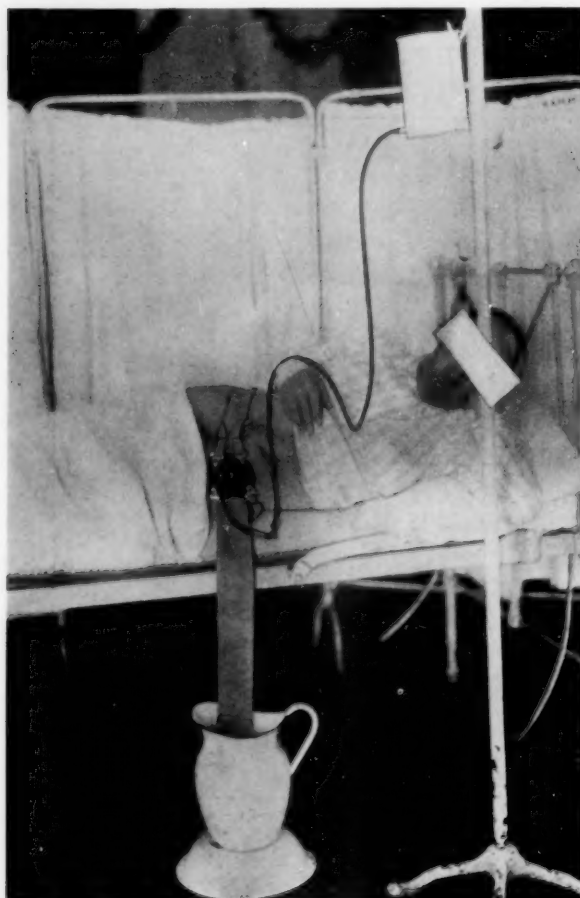


FIG. 5.—Apparatus in position, bedridden patient.

four or five feet of connecting tubing; (5) a stop-cock and connecting rod; (6) two large soft rubber outflow tubes, one short and one long; (7) a short soft rubber bag—collecting bag for residual fluid; (8) a threaded plug, to close the opening in the centre of the cup. This list includes all the special apparatus necessary for cleansing the colon through a colostomy opening in bedridden or ambulatory patients.

#### TECHNIQUE OF PROCEDURE

The irrigation of the colon is less difficult through a colostomy than through the rectum. The principles are the same in both instances, since the irrigating cup, together with the attached outflow tube, serves the same purpose as the return-flow rectal tube that is used in giving ordinary colon irrigations. The inflow catheter is inserted into the

colon for a distance of three to six inches and is not withdrawn during the irrigation. The return flow is expelled into the cup and then passes through the outflow arm of the cup into the attached extension outflow tube which is of sufficient diameter to allow the passage of large fecal masses.

When the patient desires to take an irrigation, the stop-cock is closed, and the irrigating can, filled with warm water or a weak solution of permanganate of potash, is placed upon a stand a few feet above the colostomy. Before placing the cup in position, the inflow catheter is drawn through the

## THE CARE OF THE COLOSTOMY

circular opening for the required distance, the desired direction of the outflow is determined, and the belt and appropriate outflow tube are attached. In the case of bedridden patients, the flow is directed laterally, and carried by means of the long, soft rubber tube over the side of the bed into a receptacle, while the patient lies comfortably on his side or back. The ambulatory patient, however, directs the flow downward, uses the short rubber tube, and sits on the toilet.

The cup, more easily applied when standing or lying than when sitting, is placed over the colostomy. At the same time the catheter is inserted into the colon; the straps of the belt are then tightened so that the rim of the cup forms an air-tight connection with the abdominal wall. The rubber tubing leading from the irrigating can is connected to the end of the catheter protruding from the cup. The stop-cock is released and the fluid allowed to flow into the colon until the latter is partly filled or until a feeling of fullness is produced. The flow is then stopped by closing the stop-cock. The stimulated peristalsis produced by the distension expels the colonic contents, which are conveyed into the toilet unseen by the patient. The procedure of filling the colon and allowing the contents to be expelled is repeated sufficiently often to insure the comfort of the patient for the succeeding twenty-four hours.



FIG. 6.—Apparatus in position, ambulatory patient.

The time usually required for this procedure is twenty to thirty minutes. A small amount of fluid is occasionally retained within the colon for a few minutes after the principal flow is stopped. To prevent waiting for the expulsion of this residual fluid, the attachments of the cup are changed as follows: The inflow catheter is withdrawn and the opening closed by a threaded plug; the outflow tube is removed and replaced by a short bag. The irrigating cup, while in position, is thereby converted into a temporary

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colostomy bag. This apparatus is worn for one-half hour, when it is removed, cleaned and sterilized, and laid away for use the following morning. The only dressing required after the irrigation is a few layers of sterile gauze over the opening to absorb the small amounts of exuded mucus. This pad is usually held in place by adhesive straps or binder. Patients, especially those who are corpulent, are fitted with abdominal support, which adds to their comfort and prevents abdominal hernia about the artificial opening.

Our routine care of colostomies at Memorial Hospital may be summarized as follows: The bowel is opened by cautery or knife from two to four days after operation. The morning following, the patient receives a large dose of castor oil. Two days later we begin the daily colonic irrigations, and as soon as the strength of the patient will permit, he is carefully instructed in both the open and closed methods of irrigation; at this time he is provided with his own irrigating outfit and measured for an abdominal support.

The daily irrigation of colostomies has been in vogue for many years and experience has proven this procedure to be by far the most satisfactory method of taking care of these abnormal conditions. The closed method of irrigation was started two years ago and has proven so satisfactory that it is now employed routinely at the hospital.

# CARCINOMA OF THE RECTUM AND RECTO-SIGMOID

By LEO J. HAHN, M.D.

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A CLINICAL STUDY OF ONE HUNDRED AND SIXTY CASES, FROM THE SURGICAL DEPARTMENT  
OF MT. SINAI HOSPITAL OF NEW YORK, SERVICE OF DR. A. A. BERG

THIS paper is based on a study of a series of one hundred and sixty consecutive cases of carcinoma of the rectum, seen at Mount Sinai Hospital on the service and in the private practice of Dr. A. A. Berg during the ten year period, 1916-1925, inclusive. The material will be presented according to the following outline: A. Operability. B. Treatment. C. Operative Procedures. D. Choice of Operation. E. Mortality. F. Ultimate Results.

Altogether in the ten year period, 1916-1925, there were observed on the Surgical Service of Dr. A. A. Berg at Mount Sinai Hospital, ninety-five cases of carcinoma of the rectum or recto-sigmoid. There were sixty-five additional cases among the private patients of Doctor Berg treated at Mount Sinai Hospital. Of this total of one hundred and sixty patients, nine left the hospital before studies were completed, and the one hundred and fifty-one remaining cases form the material for this study.

*A. Operability.*—The operability in cases of carcinoma of the rectum when seen by the surgeon has varied from 25 per cent. to 82 per cent. The following table shows the wide variation in the hands of different surgeons:

	Inoperable	Operable
Cripps <sup>1</sup> (445 cases) .....	75%	25%
Back <sup>2</sup> .....	70%	30%
Gant <sup>3</sup> .....	65%	35%
Chalier and Perrin <sup>4</sup> .....		20 to 50%
Lynch <sup>5</sup> (491 cases) .....	30%	70%
Berg (151 cases) .....	16%	84%

Of the one hundred and fifty-one cases under consideration, twenty-four were considered inoperable, fifteen after exploration, nine without exploration. In these twenty-four inoperable cases, the following conditions were encountered:

Local fixation to neighboring structures .....	6 times	Inguinal metastases .....	2 times
Bladder involvement .....	3 times	Other metastases .....	5 times
Vagino-rectal fistula .....	2 times	Ascites .....	2 times
Urethro-rectal fistula .....	1 time	Cachexia .....	2 times
Metastases in liver .....	6 times	Extreme old age .....	1 time
		Myocarditis .....	1 time

The conditions which bar radical operations are in general: (a) Local invasion of neighboring organs. (b) Distant metastasis. (c) Poor general condition.

(a) The neighboring structures which may be invaded are the uterus, vagina, adnexa, bladder, prostate, adherent small intestines, broad ligaments,

and the sacrum. Firm fixation of the tumor to these adjacent structures make the possibility of a permanent cure very unlikely. Mere inflammatory adhesions however do not necessarily interfere with radical removal of the tumor. The prostate or bladder in the male, and the uterus or vagina in the female, are not infrequently adherent to the growth. A hysterectomy may be included in the operative procedure when the growth is found to invade the uterus or adnexa. If bladder involvement can be determined prior to laparotomy, the case is considered inoperable due to the added operative risk of bladder resection, but if this complication should be met unforeseen at the operating table a bladder resection might be necessary. To avoid this possibility, cystoscopy should be performed whenever there are any bladder symptoms, and these should be carefully elicited while taking the history. Invasion of the sacral bone occurs but rarely, and the growth can usually be peeled from the sacrum.

(b) The presence of glandular or liver metastases must usually be left for discovery on the operating table. It should be remembered that enlarged glands in the groin are not always carcinomatous. These glands often prove to be inflammatory, and if so do not contra-indicate a radical removal of the tumor. Enlarged mesocolic glands on the other hand are more often carcinomatous, and any radical procedure must include their removal.

(c) Patients in poor general condition, or with deficient vital organs or complicating diseases, are not capable of withstanding an extensive radical operative procedure. Severe cardiacs, consumptives, severe diabetics, nephritics, etc., come in this category.

In case of doubt as to operability, it is felt that the patient should be given the benefit of an attempt at radical cure by surgery. The outlook, otherwise, is hopeless. Radiotherapy has not effected cures. This attitude accounts for the extension of the limits of operability to 84 per cent. in this series.

Here as in all cancer problems, the early diagnosis is of importance. It has often been stated that tumors in this location are rather slow growing, and therefore can usually be discovered before they have spread if only the physician will make the search. In our twenty-four inoperable cases the duration of symptoms has ranged from two to eighteen months—averaging eight months.

The first symptom which appears may be bleeding, pain, increasing constipation, diarrhoea, or rectal discharge. Hemorrhoids may be concomitant—their presence does not preclude the presence of more important disease a little higher up. Several of our cases have had hemorrhoidectomies a few months before the discovery of the cancer.

Occasionally a tumor is accidentally found in the course of a routine examination with no symptoms referable to its presence. This is a strong argument in favor of regular periodic physical examinations. Whenever a patient presents himself to a physician with any of the symptoms enumerated above, the examination should include a thorough digital examination of the entire rectum, and also a proctoscopic examination with a suitable instrument.



## CARCINOMA OF THE RECTUM AND RECTO-SIGMOID

Sigmoidoscopic examination and röntgenological examination by means of an opaque enema are used to locate lesions higher up than those which can be reached by the finger and proctoscope. In the high growths at the rectosigmoid junction especially in obese subjects, the tumor may be in a position where it cannot be palpated. Such a tumor may exist for months before ulceration will cause it to produce bleeding, pain or discharge, and may even go on to obstruction without having previously indicated its presence. A gas anaesthesia may be used if necessary to aid in determining by bimanual examination, the presence of a tumor, the approximate extent of gut involved, the amount of fixation, and the presence of intra-abdominal masses.

If a tumor mass is found, and there is doubt as to its nature—a biopsy should be performed through the proctoscope, and a Wassermann test always should be done. Lues, tuberculosis, papilloma and benign stricture are the conditions to be differentiated, and are all much rarer than carcinoma. With the diagnosis established, a search for metastatic foci is made. If bladder symptoms are present, cystoscopy is performed. A thorough general examination is made to discover complicating conditions.

*B. Treatment.*—We are offered three choices in treating a case of rectal carcinoma. (a) Palliative treatment (with or without colostomy). (b) Radiotherapy (radium and deep X-ray). (c) Radical operation.

(a) The ultimate result of palliative treatment is death accompanied by much suffering and misery. This choice obviously is only for those cases in which no hope of cure can be entertained. When for any of the reasons enumerated above a case is considered inoperable—this line of treatment must be followed. It consists in treating the pain and other symptoms as they arise, sometimes using radiotherapy as a palliative measure, and performing a colostomy when indicated.

An early colostomy is an advantage as the diversion of the fecal stream from the growth relieves the latter of irritation, lessens the diarrhoea and bleeding, and may lessen the rapidity of spread. The more thorough clearing of the bowels will relieve the intoxication of the patient. A colostomy done prophylactically prevents the necessity of performing it as an emergency after the onset of obstructive symptoms, when the general condition will be much worse and the healing powers at a low ebb.

Early colostomy requires the patient to live a colostomy life longer than is strictly necessary, but it is far from unbearable. Several inoperable patients have lived for many months in comparative comfort with a colostomy.

Cripps<sup>1</sup> compares two series of inoperable cases in only one of which colostomy was done.

In 71 cases in which NO operation was done	In 97 cases in which COLOSTOMY was done
33 lived less than 6 months	10 lived less than 6 months
31 lived 6 to 12 months	11 lived 6 to 12 months
7 lived 1 to 3 years	62 lived 1 to 3 years
Average 7.8 months	Average 22.0 months

In 21 cases with colostomy after obstruction had occurred 11 died following colostomy  
In 130 cases with colostomy before obstruction had occurred 5 died following colostomy

(b) In our experience and in that of many other men, radiotherapy used alone has not resulted in radical cures. In the earlier days it was the cause of much suffering, tenesmus, diarrhoea and colitis. This has been lessened to some extent by improved methods of application and dosage, but is still far from ideal. Of what value pre-operative or post-operative radiotherapy for rectal carcinoma will prove to be we do not know yet. Radiotherapy may be useful as a palliative measure, but so far does not offer us much hope of permanent cures.<sup>11</sup>

(c) Therefore if radical surgical methods can present us with even a reasonable number of cured patients, we believe that it is worth while undergoing a considerable risk to attain that object. Furthermore we feel that even in the cases which have not been permanently cured, the removal of the rectal tumor by relieving the tenesmus, bleeding and other painful local manifestations, has succeeded in allowing these patients many months, or even years, of increased comfort.

*C. Operative Procedures.*—In this series 3 type operative procedures have been made use of: (a) Amputation by sacral approach (Kraske type). (b) Combined abdomino-sacral resection (with preservation of sphincters). (c) Abdomino-sacral amputation with abdominal colostomy (Quenu-Hartmann type).

(a) The simple Kraske type, or sacro-perineal amputation of the rectum, consists of an attack through a posterior parasacral incision—an amputation of the tumor-bearing part of the rectum and the anus, and a colostomy performed by implanting the severed end of the gut in the sacral wound. The coccyx is removed, the posterior layer of the pelvic fascia incised, the growth located. The peritoneum of the cul-de-sac is opened on both sides of the rectum, the vessels of the mesentery ligated, and the rectum pulled down. The peritoneum is then closed by suture. The growth, lower rectum and anus, are then amputated using clamps, and the lower end of the gut implanted into the sacral wound. The wound is then closed with drainage. (If the tumor is high enough to make saving the sphincter possible, a resection with end-to-end anastomosis may be performed instead of an amputation.)

This operation has been largely used in the past, and had in its favor its simplicity—the absence of shock, and an extremely low operative mortality. Its disadvantages are mainly the lack of an opportunity to explore the abdomen—and of much less importance, the inconvenience of a colostomy placed in the sacral region.

This operation has been used very infrequently in the recent cases in this series. In later years it has been used as the operation of necessity when the operation of choice was contra-indicated. It was used thirty-four times in the series with two deaths (6 per cent.). Of these deaths one occurred in a woman of seventy-three on the ninetieth day, from a late pulmonary complication—the other occurred on the second day in a severe cardiac.

## CARCINOMA OF THE RECTUM AND RECTO-SIGMOID

This type of operation has been used in other clinics with the following results:

	Mortality	Cures
Hochenegg <sup>6</sup> (500 cases) .....	19%	20%
Mayo <sup>7</sup> (27 cases—2 deaths) .....	7%	
Cripps <sup>1</sup> (108 cases—8 deaths) .....	7%	39%
Hartmann collected cases* (1616 cases—257 deaths) .....	16%	551 recurrences in 805 cases traced
Berg (34 cases—2 deaths) .....	6%	

(b) The combined abdomino-sacral resection in continuity with an end-to-end anastomosis, and preservation of the anus and sphincters is performed by Doctor Berg in one sitting as follows:

The first part of the operation is a laparotomy through a low midline incision with the patient in the Trendelenburg position. The liver and retroperitoneal lymph-nodes are first examined, and a search made for metastatic deposits. The tumor is then located, and adhesions to adjacent intra-abdominal viscera separated. An incision is made through the peritoneum of the meso-sigmoid on both sides. The superior hemorrhoidal vessels are ligated after deciding upon the level of resection, and marking this level with a tape. The lower sigmoid and rectum are mobilized as much as possible by blunt dissection. The blood supply of the part of the gut which is to remain is investigated and assured. A protective pad is placed in the abdomen under the line of incision, and a temporary closure of the abdomen is made with through and through silk sutures.

The patient is then placed on his right side. An incision is made along the left border of the lower sacrum and curved around the coccyx. The coccyx is removed. After incision of the intervening peri-rectal fascia, the mobilized rectum is drawn down through the sacral wound. The wound is now protected by pads and a resection in continuity performed between clamps, using the tape as a guide to the upper level. A margin of healthy gut must be excised on both sides of the growth. An end-to-end anastomosis is performed with chromic catgut sutures after inserting a rubber tube through the anus and up past the level of anastomosis. Ample drainage is provided and the muscles and skin closed with interrupted sutures. A dressing is placed over the wound.

The patient is now replaced in the Trendelenburg position. With clean gloves and gown, the abdomen is re-opened, the pad removed—and the pelvic peritoneum repaired so as to extraperitonealize the anastomosis. The gut is again inspected to be sure of the blood supply, and the abdomen is then closed without drainage. The anastomosis, of course, usually leaks, as the gut in this location lacks a complete peritoneal covering. However, the fecal fistula which develops always closes after a period. With a proper preliminary preparation of the bowels, the posterior wound becomes a healthy granulating wound before it is exposed to the fecal discharge, so that toxic absorption from this area does not ordinarily become a factor in the post-operative course.

This combined operation has on occasions been completed in an hour, and the records will show that the operation does not often produce severe shock. Two deaths in fifty-four cases were ascribed to shock.

The chief advantage of this operation is that it leaves the patient a normally functioning anus with complete control of the bowels. A tendency to stricture formation at the site of anastomosis occurs in some of the cases, but dilation with bougies effects a rapid improvement of this condition.

(c) The Quenu-Hartmann operation used in this series is an abdomino-sacral amputation of the rectum with abdominal colostomy. A laparotomy is performed through a midline incision with the patient in the Trendelenburg position. An exploration is made, the peritoneum in the cul-de-sac is incised on both sides of the sigmoid, and this incision is carried across the serosal covering of the sigmoid. The gut is mobilized and the upper level of resection decided upon. The blood supply to the lower sigmoid is ligated. The gut is tied with tapes, divided between the two tapes and the mucosa is carbolized. The lower fragment along with the affected mesocolic glands are now pushed down into the pelvis, and the pelvic peritoneum is repaired—extraperitonealizing the fragment to be removed. The upper fragment of sigmoid is now implanted into the abdominal wall through the incision or a separate stab wound, to form a colostomy which will be opened several days later. The abdominal wound is closed in layers.

The patient is then placed on his right side—an incision made over sacrum and coccyx, and extended around the anus which has previously been closed by suture. The coccyx is removed. An incision is made in the fascia, and the rectum is pulled out through the wound, and removed en bloc down to the anus. The wound is then closed with drainage. This method would seem to be ideal from the standpoint of radicalism as a thorough removal of the diseased area can be accomplished. Moreover there is a great shortening of the period of hospitalization when this method is used, and the wounds usually heal rapidly and cleanly.

*D. Choice of Operative Procedure.*—In selecting the proper procedure to use in a case of rectal cancer, the main objective must be kept prominently in mind, *i.e.*, the complete removal of all disease. All secondary considerations must be sublimated to this issue.

Cancer of the rectum spreads in three ways. (a) By direct extension. (b) By way of the blood stream. (c) By way of the lymphatic stream.

(a) Handley<sup>9</sup> in 1910, reported one case in which he found an extensive spread of carcinoma along the submucous lymphatics in the wall of the gut beyond the gross limits of the tumor. This report led surgeons to question whether the many recurrences were not due to the fact that the gut was being resected too close to the visible growth, leaving behind gut with affection of the submucous layer. However, few of our recurrences have occurred higher up in the gut wall, or at the site of anastomosis. They are more apt to appear in other situations, in the scar, liver and retroperitoneal glands.

It appeared that the importance of Handley's report was exaggerated

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when in 1914, Cheate<sup>10</sup> reported the results of some interesting observations, which showed that Handley's was a rare case, and that in most cases the submucous spread does not extend further than the extramural lymphatic spread. Therefore a wide removal of the bowel far beyond the-visible involvement is not essential.

(b) Hæmatogenous extension of these tumors results from the invasion of the tributary veins mainly of the portal system with metastatic deposits in the liver. They may occur on any surface of the liver or concealed within the organ. Apparently the lower hæmorrhoidal tributaries which drain into the hypogastric vein become involved less often as judged by the infrequent occurrence of pulmonary metastases.

(c) Lymphatic extension occurs mainly in two directions. The lymphatics of the anus pass forward to the inguinal glands. Those from the anal canal pass up along the hæmorrhoidal vessels to the hypogastric chain. These lymphatics perforate the rectal wall both above and below the levator ani, the latter ones traversing the fat of the ischio-rectal fossa, and end in glands near the origin of the internal pudic artery in the pelvis. (Poirier and Cuneo.) The lymph-vessels of the ampulla of the rectum pass up to the sigmoid mesocolic glands which drain to the pre-aortic glands near the origin of the inferior mesenteric artery.

In order to investigate the intra-abdominal spread of the disease by both the hæmatic and lymphatic routes, a laparotomy is necessary. It would be unjustifiable to subject a patient to a radical rectal amputation if discoverable metastases were already present within the abdomen. Recognition of this point has led practically to the discarding of the simple Kraske type of operation, so that in the last six years of the series this latter procedure was used very infrequently (in six cases), and is now used in cases in which there are contra-indications to the more extensive procedures, particularly in very old, feeble or obese individuals.

It would be fortunate for the patient if the normal anal control could be preserved for him without sacrificing the main object of the operation, the radical removal of all tumor tissue. This anal control is of course dependent on the preservation of the sphincter muscles and their nerve supply.

The innervation of the sphincter comes mainly through the inferior hæmorrhoidal branch of the internal pudic nerve. It leaves the internal pudic in Alcock's canal, and traverses the ischio-rectal fossa to the sphincter muscle. The ischio-rectal fossa contains lymphatics which drain the anal canal. So when the tumor is low, and these lymphatics may be involved, the ischio-rectal fossa must be cleaned out thus destroying the innervation of the sphincters. This does not apply, however, in cases in which the tumor is in the higher part of the rectum, and in those cases there would not be this objection to the retention of the sphincters.

The recent work of Villemain<sup>12</sup> and his co-workers has shown that the third valve of Houston is the borderline between what they term the high rectum and the low rectum. Growths exclusively above this level do not



drain laterally or downward, but only upward. It is in these cases, where the tumor is high enough to avoid lymphatic extension through the ischio-rectal fossæ that the combined abdomino-sacral resection is chosen, so that the sphincters and anus may be preserved. It is very gratifying to find that some of our patients are perfectly well years after resection for carcinoma, with perfect control of the bowels through the normally situated anus. Blake<sup>13</sup> also in a recent report cites a patient well fourteen years after operation with normal sphincter control.

If any part of the tumor lies lower than the third valve of Houston the sphincters must be sacrificed, and a colostomy must be made. An abdominal colostomy is preferred to one in the sacral region for several reasons. It can be better cared for by the patient and kept cleaner, being visible to him. With an abdominal colostomy there need be no stinting in the amount of gut amputated. There seems to be a greater tendency for scar contraction of the stoma requiring repeated dilatations when the colostomy is in the sacral region. Also in this latter location there is often a tendency to prolapse.

In those cases in which the tumor extends below the third valve of Houston, the Quenu-Hartmann type of operation with its abdominal colostomy is preferable. This operation is also selected if for any reason an anastomosis cannot be performed without tension.

A preliminary colostomy is advocated by some authors. In cases with symptoms of obstruction, there can be no disagreement with this viewpoint, but in non-obstructive cases a preliminary colostomy is unnecessary, and is undesirable. Its presence increases the risk of infection if a second incision for the major operation is to be made through the abdominal wall. It leaves less freedom for mobilization of the tumor.

Stimulated by the high mortality of the combined operation in their cases, particularly by the deaths ascribed to surgical shock, a number of operators have advised dividing these operations into two stages hoping in that way to lower the mortality. Several plans have been advanced for these two stage operations.

Lockhart-Mummery<sup>14</sup> limits the first stage to a colostomy with exploration of the abdomen. He then leaves the entire mobilization of the tumor and its extirpation for the second operation, performed from the back. This plan may work well for the low tumors, but is not intended for the tumors at the recto-sigmoid junction. In his operation the patient is always left with a blind loop of sigmoid below the colostomy to which accidents may occur, and which occasionally may result in a permanent posterior fistula.

Jones<sup>15</sup> performs some mobilization of the tumor, and a dissection of the pelvis at the first operation, preserving the blood supply to the lower bowel by ligating the inferior mesenteric artery just below the left colic branch. A colostomy is sometimes added. An extraperitoneal amputation is performed at the second operation through a sacro-perineal incision.

Mayo<sup>7</sup> remodelled the Quenu-Hartmann operation as a two-step procedure. The first stage was to sever the sigmoid, implant the upper end as a colostomy, and after mobilizing and closing the lower fragment, pushing it into the pelvis where it was extraperitonealized. About one week later the second stage was performed as a sacro-perineal amputation. In 1912, he reported a death from perforation of the distal segment while the patient was awaiting the second stage.

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This accident stimulated Coffey<sup>10, 18</sup> to improve upon this operation. Coffey severs the sigmoid, uses the proximal fragment for the colostomy, inverts the closed lower fragment pulling it through the anus when possible, and then provides a tampon drainage suprapubically in the male, and vaginally in the female, to seal off the septic field from the peritoneal cavity. The second stage is an amputation through the sacro-perineal route.

Any adequate two-stage operation should provide for mobilization of the tumor from the abdominal side and consequently in the first stage. Otherwise the thoroughness of the removal of the upward spread of the tumor cannot be assured. This mobilization, if adequate, requires considerable dissection and opening up of fresh tissue planes—all of which are thus made into receptacles for deposit of tumor cells through the severed lymphatic channels while waiting for the second operation. The cancer remains in the pelvis during this time pouring out cancer cells through the lymphatics, which have been opened up at the first operation.

This is an important objection to the two-stage operation. Our series will show that that part of the mortality due to shock is small, and therefore we do not believe it necessary or wise except in very exceptional cases to divide the operation into two stages. All except two of the operations in this series have been performed at a single sitting.

### SUMMARY

The location and extent of the tumor and general condition of the patient determine the type of operation to be used.

(1) The simple Kraske type of operation should be reserved as the operation of necessity for patients whose general condition does not warrant the risk of a more extensive procedure (obesity, old age, deficient vital organs).

(2) The combined abdomino-sacral operation with resection in continuity is selected for cases in which the growth is high in the rectum as in these cases the lymphatic involvement does not extend through the sphincters or the ischio-rectal spaces. Bowel control can then be preserved.

(3) The Quenu-Hartmann type is used when an anastomosis cannot be safely performed, and in cases where the mesenteric glands are so involved as to require a high resection of the sigmoid; and particularly in all cases which involve that portion of the rectum below the third valve of Houston.

(4) In non-obstructive cases each of these operations should be performed at one sitting.

*E. Mortality.*—In considering the statistics of this series all deaths within one month after operation are included in the operative mortality. There were three additional deaths in the hospital occurring thirty-six days, ninety days, and six months after operation. These three deaths occurring so long after operation are not included in the operative mortality, but are discussed in the following paragraph.

There were twenty-five deaths in the hospital, four on the first day, eleven occurring on the second to the seventh days, seven more in the first month, and three after one month. One death occurred ninety days after operation in a woman of seventy-three with pulmonary signs. One man who died of

metastases six months after operation had remained in the hospital simply because he could not be cared for at his home. A death on the thirty-sixth day was due to pulmonary embolism (autopsy). Omitting these three deaths which occurred more than one month after operation, we have an operative mortality for the entire series of 18 per cent. (20 per cent. including the three cases mentioned above). In comparing these figures with those of other surgeons, it must be remembered that the limits of operability has been stretched to 84 per cent. in this series, so that probably more bad risks have been included than were included in the other reported series with which we are familiar. More conservative selection of cases would have decreased the mortality, but would also have refused their only chance of cure to many of these patients.

*Causes of Death.*—(a) *Infection.* No deaths from infection occurred in the simple Kraske or Quenu-Hartmann types. Five occurred among the combined resections with anastomosis. Our experience has varied from that of Mayo,<sup>15, 17</sup> who ascribes a large proportion of his mortality to sepsis. Of the deaths due to infection, one was due to a gangrenous cystitis and pelvic abscess, two to peritonitis, one to a severe infection of both wounds, and one more probably to peritonitis. In one case a preliminary colostomy was first performed for obstruction. The patient also suffered from myocarditis and nephritis, and was a diabetic. She developed peritonitis following the radical operation performed two weeks after the colostomy was established.

(b) *Pneumonia.*—Pulmonary complications were responsible for one third of all the deaths. Of the nine deaths in the Quenu-Hartmann cases, five were ascribed to pneumonia. This was the proven cause of death by autopsy in one case, by X-ray in two cases, and by medical consultation with the late Doctor Brill in one case. In the future it is almost certain that the pulmonary complications will be lessened by the use of spinal anaesthesia. Had these pulmonary deaths been saved in this series, the mortality of the Quenu-Hartmann group might have been as low as 12 per cent.

Diabetes was a factor in three of the fatal cases.

(c) *Shock.*—Most important are the five deaths ascribed to shock. We wish to call attention to each of these cases.

(1) In this case, the operation was of the Quenu type, but a panhysterectomy had to be included. The time was one hour and fifty-five minutes. There was a sudden death five hours after operation charted as "pulmonary embolism or acute dilatation of the heart", but no autopsy was obtained, and the death may have been due to shock.

(2) This was really an inoperable case, in which the rectal irritation, bleeding and tenderness were so severe that a palliative removal of the rectum was performed. The patient had come up from Mexico for an operation as a last resort, and was in very bad shape. The operation required one and one-half hours—during which a transfusion was required. The bladder was adherent to the growth, and small intestine required resection. Death occurred on the following day.

(3) This patient died in twenty-four hours. There was considerable oozing from the posterior wound.

(4) This patient died in three hours. It is not certain whether he did not have an internal hemorrhage.

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(5) This was a woman of sixty in whom hysterectomy was required as part of the operative procedure. The time was one hour and forty-six minutes. Death occurred within twenty-four hours.

Of the five patients who were lost from shock, three had complicating conditions, which could hardly have been managed by a two-stage procedure with any different result. The other two lost considerable blood, and the shock was secondary to hæmorrhage.

It is difficult to see how a two-stage procedure would have saved these cases, other conditions, remaining unaltered. Certainly a lowered mortality from shock is the main attractive point in favor of dividing the operation into two parts. In our series we doubt whether any of these deaths would have been avoided by using a two-stage procedure.

In this series only two operations were done by two-stage technic. Both of these patients died. Eliminating these two cases, for purposes of comparison, we have a mortality of 16 per cent. for the single stage operation.

Some significance must be attached to the fact that the private patients had a mortality lower by one third than that of the ward patients.

Private cases .....63 cases.....10 deaths or 16%  
Ward cases .....64 cases.....15 deaths or 24%

The private patients come to the surgeon earlier, are in better general condition, and have the benefit of special nursing care.

For comparison we borrow from the literature the following data:

	No. Cases	Operability	No. Radical Operations	Type Operation	Mortality
W. J. Mayo, <sup>19</sup> 1897-1909.....	753	53%	120	All types	16%
W. J. Mayo, <sup>17</sup> 1893-1915.....			430	All types	15.5%
W. J. Mayo, <sup>7</sup> 1910-1912.....			14	1 stage comb.	35%
			30	2 stage comb.	13%
W. J. Mayo, <sup>17</sup> 1913-1915.....	277	71.8%	199	All types	12.5%
Quoted by Mayo <sup>7</sup> :					
Miles.....			42	1 stage abdomino-perineal	40%
Wallis.....				1 stage abdomino-perineal	40%
Hartmann.....				1 stage abdomino-perineal	25%
Kraske.....				1 stage abdomino-perineal	40%
Hartmann, <sup>8</sup> collected cases...			260	Comb. Kraske	37%
Chalier and Perrin, <sup>4</sup> 1913.....			126	Quenu-Hartmann	42%
			208	Comb. Kraske	40%
Jones <sup>15</sup> .....			16	2 stage	18%
Bach, <sup>2</sup> 1919.....	491	84%		Quenu-Hartmann (Selection of cases)	20%
Lynch, <sup>5</sup> 1918.....			335	All types	16%
Berg.....			127	All types	18%
				1 stage comb. Kraske	19%
				1 stage Quenu	26%
				Omitting two-stage operations in both of which death occurred	16%

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## STATISTICS OF SERIES

### I.

Number of Radical Operations .....	127	
Operative Mortality .....	22 cases	18%
Operative Mortality inclusive of 3 deaths after one month .....	25 cases	20%

### II.

Type of Operation	No. of Cases	Deaths	Mortality
Simple Kraske .....	34	1*	3%
Combined Resection .....	55	10†	19%
Quenu-Hartmann Amputation ..	34	9	26%
Atypical .....	4	2	50%

### III.

#### Cause of Death.

	Thoracic	Infection	Shock	Miscellaneous
Simple Kraske .....	2	0	0	0
Combined Resection .....	2	5	3	2
Q-H Amputation .....	7	0	2	0
Atypical .....	1	1	0	0
Totals .....	12	6	5	2

Thoracic causes of death	Pneumonia .....	8‡
	Cardiac .....	2
	Pulm. Emb. ....	1
	Cerebral Emb. ....	1
Infection	Peritonitis .....	3 (plus 1?)
	Severe Wound inf .....	1
	Pelvic abscess .....	1
Miscellaneous	Metastases—cachexia (6 months after operation) .....	1
	Prolapse of viscera and intestinal obstruction .....	1

### IV.

#### Time of Death.

	1st day	2-7 day	8-30 day	31st day plus
Simple Kraske .....	0	1	0	1
Combined Resection .....	3	2	5	2
Q-H Amputation .....	1	6	2	0
Atypical .....	0	2	0	0
Totals .....	4	11	7	3

*F. Ultimate Results.*—Unfortunately ultimate results in many of these cases are unobtainable. The ward patients are extremely difficult to follow

\* One additional death on 90th day.

† Two additional deaths on 36th day and 6th month.

‡ In four of these eight cases, there is indisputable evidence of pneumonia; in the other four cases it cannot be proven that pneumonia was the actual cause of death but this seems probable from the records.



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in New York City where this type of patient moves frequently and often leaves no trace.

The private patients have been followed more easily. The follow-up records of the private cases have been furnished to me from Doctor Berg's office records.

## Ward cases

64	Total no. of cases.....	127
15	Deaths in hospital .....	25
—	—	—
49	Survived operation .....	102
30	Not traceable 1928.....	43
—	—	—
19	Result known .....	59
17	Deaths probably from cancer or recurrences .....	41
—	—	—
	Died of other causes—free of cancer .....	2
2	Known to be well.....	16
3%		12½%

## Private cases

63
10
—
53
13
—
40
24
—
2
14
22½%

Sixty per cent. of the survivors of the operation in ward cases are not traceable, and these records are therefore of little value. In the private cases, however, the results to date are known in 80 per cent. of the cases. A more detailed analysis of the private cases is therefore appended.

## Private Cases.

Simple Kraske		Quenu
No. of cases.....	14	14
No record .....	4	4
Op. death .....	2	2
Died presumably of cancer.....4	$\left\{ \begin{array}{l} 1 \text{ yr.} \\ 1 \text{ yr.} \\ 1\frac{1}{2} \text{ yrs.} \\ 8 \text{ yrs.} \end{array} \right.$	$\left\{ \begin{array}{l} 1 \text{ yr.} \\ 1 \text{ yr.} \\ 1 \text{ yr.} \\ 1\frac{1}{2} \text{ yrs.} \\ 4 \text{ yrs.} \end{array} \right.$
Dead of other causes, 1—3 yrs., no known recurrence		
Well to date.....3	$\left\{ \begin{array}{l} 5 \text{ yrs.} \\ 9 \text{ yrs.} \\ 11 \text{ yrs.} \end{array} \right.$	$\left\{ \begin{array}{l} 4 \text{ yrs.} \\ 6 \text{ yrs.} \\ 8 \text{ yrs.} \end{array} \right.$

## Combined Kraske

	$\left\{ \begin{array}{l} 1..4 \text{ mos.} \\ 9..1 \text{ yr.} \\ 2..2 \text{ yrs.} \\ 1..3 \text{ yrs.} \\ 1..4 \text{ yrs.} \\ 1..5 \text{ yrs.} \end{array} \right.$	No. of cases..... 33 No record .....	5
Died presumably of cancer..15		Operative death .....	5
Died of other causes—1-6 years			
Atypical Cases		Well to date.....7	$\left\{ \begin{array}{l} 4 \text{ yrs.} \\ 7 \text{ yrs.} \\ 7 \text{ yrs.} \\ 10 \text{ yrs.} \\ 10 \text{ yrs.} \\ 10 \text{ yrs.} \\ 11 \text{ yrs.} \end{array} \right.$
..... 2			
..... 1 well 12 years			
..... 1 operative death			

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## Combined results of private cases

Cases .....	63		
Operative deaths .....	10		
Survivors .....	53		
	13 no record		
Died of cancer .....	24	{ 15..1 yr. 4..2 yrs. 1..3 yrs. 2..4 yrs. 1..5 yrs. 1..8 yrs. 1..9 yrs.	{ 2..4 yrs. 1..5 yrs. 1..6 yrs. 2..7 yrs. 1..8 yrs. 1..9 yrs. 3..10 yrs. 2..11 yrs. 1..12 yrs.
Died of other causes .....	2	{ 3 yrs. 6 yrs.	{ 14

It may be noted that of the sixty-three private cases there were thirteen five-year cures up to the early part of 1928. It must also be noted that one patient died in the fifth year from a metastasis in the lung, and one in the eighth year of a recurrence in the prostate. How long an interval after operation should be required as evidence of cure is therefore open to argument. The seven, five-year cures among the cases which were operated by the method which involves the saving of the sphincters are evidence that in properly selected cases it is possible and distinctly worthwhile to avoid a colostomy.

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## A STUDY OF THREE HUNDRED FORTY-THREE SURGICAL CASES OF INTESTINAL OBSTRUCTION

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THE outstanding consideration in any study of intestinal obstruction is the appalling mortality. In no acute abdominal condition is the death rate such as to give us of the medical profession any reason for complacency, but in none of them does it approach the rate of intestinal obstruction, in which, although ordinarily stated to be between 30 and 40 per cent., actually it ranges between 55 and 65 per cent.

In the present study, which is based on 343 surgical cases treated during the last five years at Charity Hospital and Touro Infirmary (New Orleans), and which includes all instances of complete obstruction with the single exception of post-operative ileus (non-mechanical obstruction), there were 209 deaths, a gross mortality of 60.9 per cent. The unrevised figures from the two hospitals, which include all cases diagnosed as intestinal obstruction, no matter what their degree and type, give a mortality for each institution of slightly less than 40 per cent., whereas our revised figures show a mortality for Charity Hospital of 65 per cent. and for Touro Infirmary of 50.5 per cent. This difference entirely corroborates the general belief that the mortality for the condition is very much higher than it is ordinarily supposed to be, and nothing is to be gained by denying the discrepancy. The bald truth is that we are stultifying ourselves in this matter, we are accepting the figures for all sorts of cases—and even they are black enough—as the figures for the acute, complete cases, which actually are from 20 to 30 per cent. higher.

The character of acute abdominal pathology is not always to be gauged by the time which has elapsed since the onset of symptoms, for fatal complications may ensue in an unbelievably short time, but the prognosis is invariably dependent on it, and it is safe to assert as a working rule that the longer surgical intervention is delayed the smaller will be the patient's chance of recovery. This is particularly true of intestinal obstruction, in which actual figures show that the mortality rises approximately 1 per cent. with each hour of procrastination, and in which, as Moynihan puts it, any mortality over 10 per cent. should be regarded as the "mortality of delay".

In complete intestinal obstruction death is inevitable unless surgery is done, and the fact that death is so often a concomitant of surgery is no reflection upon that mode of treatment. Instances of spontaneous rectification of the pathology are so rare that they may be set down as chimerical, and the cold facts are that the alternatives are surgery or death, and that sometimes there is no alternative, for I venture to say that probably 20 per

cent. of these patients are operated on when there is not more than a 1 or 2 per cent. chance for their recovery. They are frankly moribund and operation is simply the surgeon's habitual gesture, as it were, and the patient's viaticum. As Lincoln Davis vividly puts it, no surgeon operates for a "batting average". If he did, if he selected for operation only those patients in whom there was a chance for cure, his surgical record would undoubtedly be improved, but he would be the poorer surgeon for it, for he would have withheld from dying men and women the mechanical relief which provided for them their only frail hold on life.

As to the reason we receive these patients in such desperate straits, that is another matter, and for it are responsible all three people finally implicated in the case, the patient himself, the medical man and the surgeon. The patient himself has no small responsibility for his own condition, though I do not recollect that I have anywhere seen this point stressed. In the first place, the instinct of the average lay person seized with abdominal pain is to doctor himself, and I know no more pernicious belief than the almost universal one of regarding a dose of salts or some similar medication as the panacea for all intraabdominal ills. In this series, not one patient but many patients doctored themselves in this manner, not only for one or two days, but for four, five and six days. In the second place, fear of surgery plays no small part in their delay in seeking medical consultation. I have repeatedly seen patients, and have finally operated on them, who were "opposed to surgery", who were willing to trust themselves to the non-existent chances of medical recovery in a condition which only surgery could aid merely because they feared the knife. In this series four patients after their admission to the hospital refused operation for hours and even days, and in a group of sixteen non-surgical cases also reviewed, six patients likewise refused operation, in two instances being removed from the institution by their relatives when they were almost moribund. Within sight of water they perished of thirst. You cannot operate on people against their will, and education of the laity to the fearful consequences of delay is the first step toward reducing the mortality of intestinal obstruction.

When I speak of the responsibility of the medical man I know that I am treading on dangerous ground. I shall have something to say, in due course, of the surgeon and his part in this sorry story, but it cannot be denied that most often he does not see the patient until it is too late for his or any other mortal ministrations. The medical man does see the patient first, and too often he does delay, giving cathartics and enemata, making elaborate laboratory tests, hoping from hour to hour and day to day that expectant treatment will halt the steadily downward course of the pathology, until it is all too evident that no treatment at all will avail. Sir William Taylor may be too bitter when he speaks of the "inexcusable ignorance or carelessness of general practitioners, who see these cases early and treat them medically, thereby laying themselves open to actions at law for malpractice if not for manslaughter", but there is more than a germ of truth in his remarks.

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Yet surgeons also delay. Twenty-eight of the thirty-two patients in this series who were operated on after a delay in hospital of from twelve hours to five days had themselves no share in the delay; it was the surgeons who waited, and the fact that there were twenty-two deaths in this particular group makes the record a very black one. Vick's idea is not altogether a poor one, that the symptoms of intestinal obstruction be made a routine question in all medical examination papers, both to impress the student with the seriousness of the condition, and in the hope that if he remembers the diagnosis under these circumstances, he is not so likely to overlook it when he meets the condition in actual practice.

In another regard, too, the surgeon is open to blame—all of these operations are of the gravest type, and yet too often, chiefly because of the seniority system in our hospitals which Codman and others have inveighed against, they are undertaken by young, inexperienced men, who may possess manual dexterity but who lack that greater gift, the surgical judgment which comes only with the years. It is quite true that even an inexpertly performed operation done early may give better results than the most finished surgery done later, but in these days of many hospitals and many available surgical consultants, such a choice need seldom be made.

Another reason for the high mortality of intestinal obstruction is that its dual character is so often overlooked. It would seem logical, since mechanical blocking of the intestinal tract is the occasion of the pathology, that the mere removal of the obstruction would result in a cure, but this is far from the truth. The mechanical obstruction with the consequent stoppage of the fecal current is only the beginning; it is not nearly so important as the sequelæ, interference with the circulation, damage of the bowel wall with ultimate gangrene, and the production of toxins. It is for this reason that only in the early stages is the mere relief of the obstruction sufficient. Indeed, in the late stages, the relief of the obstruction, which permits a rush of toxic substances into the yet intact bowel or which permits the return of the circulation to a necrotic loop, is in itself a very dangerous procedure, and we are confronted with the paradoxical situation of doing the patient harm by the very means employed to do him good.

Nor is this all of the dilemma. Even in apparently early cases mere relief of the obstruction may not be sufficient, for a paralysis, particularly if there has been marked distention, may persist after the original mechanical trouble has been corrected, while in late cases, even if the toxemia be relieved by drainage of the bowel and other adjuvant measures, the patient may die of his unrelieved primary condition. Finally, even the fact that the patient is seen early and is in apparently good condition does not necessarily mean that lethal toxins have not already been produced in fatal quantities. In short, operation for intestinal obstruction is a three-fold problem, involving as it does not only the relief of the actual obstruction, but also the management of the damaged bowel and the combating of toxemia.

The clinical aspect of every case of intestinal obstruction is the essential



aspect, yet even here confusion arises from the fact that in the operable stage any or all of the classic symptoms may be lacking. Surgical textbooks are decidedly misleading on this point, for they tend to stress the terminal symptoms, "the signs of lost opportunity", as Sampson Handley calls them, rather than the initial symptoms. It is surprising to note how often a carefully taken history will elicit vague premonitory symptoms, which seem to warrant Deaver's statement that few abdominal catastrophes are the result of "virgin pathology", and Moynihan's, that most of them "mark an abrupt transition from the quiescent to the acute stage in a disorder of long standing". In about a fifth of the cases in this series the patients furnished histories of vague abdominal distress culminating finally in acute attacks, though such cases are in no way allied to the usual "chronic intestinal obstruction". Such a careful history will also bring out the existence of a hernia, for instance, even before the physical examination discloses its presence, or will elicit the fact of a previous operation. That the latter is a particularly important consideration is evident from the fact that 24.2 per cent. of the patients in this series gave a history of previous abdominal operation, chiefly for pelvic conditions or acute appendicitis, while in Finney's series 40 per cent. of the patients had previously been operated on. In fourteen of the cases in my series, 16.9 per cent. of this special group, the surgery had been done within the preceding three weeks. These figures, I might say parenthetically, make plainly evident the necessity for early operation in acute appendicitis, so that drainage may be avoided, and also point to the importance of covering all raw surfaces in pelvic work.

It is commonly agreed that the earliest symptom of acute intestinal obstruction is pain, usually sudden and acute, at first colicky and intermittent, but finally continuous, and always continuous from the onset if the mesentery is implicated. It may originate in the epigastrium, though more usually it originates about the umbilicus, and finally it involves the whole abdomen. It was complained of by three-quarters of the patients in this series, and Tuttle and Finney give roughly the same proportion.

Vomiting was complained of by practically the same number of patients, and is unquestionably the second most important symptom. The quantity and type depend upon the site of the obstruction, and in colonic involvement this symptom may not be apparent until the late stages. Usually frequent and copious, the vomitus consists first of gastric contents, then of bile-stained fluid, finally of true fecal material. This fecal vomiting is ultimately effortless and is due to the high pressure of fluid and gas, being comparable to the escape of gastric contents through the nose and mouth at or just after death, when putrefactive distention of the abdomen comes on. It is, as Sampson Handley says, "not a symptom of disease but rather a sign of impending death". According to the records, it was exhibited by forty-five patients in this series, of whom thirty-five died, and my personal opinion is that in the ten patients who survived, the vomitus was not of the true fecal type but consisted rather of small bowel contents. It must be

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remembered, too, that obstruction of the small bowel may check or prevent fecal vomiting, since the mechanical obstruction may act upward as well as downward.

Absolute constipation, while undoubtedly a frequent symptom, must be accepted as such with caution. If it exists it is pathognomonic, but it may not always exist. It was present in only about half of the cases in this series and other studies corroborate these figures. In intussusception and mesenteric thrombosis frequent thin, watery, blood-stained stools are more usual than obstipation, and while obstruction in the right half of the colon clinically is evident as obstipation, in the left half diarrhea is the rule. Moreover, the higher the obstruction is located the longer will it take to demonstrate it, even with the aid of enemata and flushes.

Physically we are in even worse case. It is true that distention is a constant and progressive feature of intestinal obstruction, but it is seldom present at the onset. In this series as well as in Tuttle's, it was noted in only a third of the cases, and in Finney's series it was noted in only half. In acute cases it tends to be rather late, and it is always late when the upper small intestine is implicated. As a rule, the lower the obstruction the prompt and more pronounced the distention is likely to be, and in obstruction of the lower colon and sigmoid it may seriously embarrass respiration.

Tenderness is always a late feature, seldom being apparent until after distention has occurred. When localized peritonitis is present rigidity is usually associated with it, but rigidity is not a constant sign, and its absence differentiates intestinal obstruction from other abdominal diseases of an inflammatory nature. Visible peristalsis is pathognomonic but it can be demonstrated only rarely, and the same is true of most of the other physical signs which are real aids to diagnosis.

In the present series all of the symptoms and physical signs ordinarily ascribed to intestinal obstruction were present in the collective group, but in no single instance was the full classic syndrome present. In eleven cases, seven of them fatal, the diagnosis was clouded by the fact that definite dietary indiscretions preceded the attack. Emaciation, dehydration and acidosis were noted in individual cases, and uremia played a part in the fatal outcome in three patients who were admitted with complete suppression of urine. In six patients with umbilical and ventral herniae, all of whom died, the weight ranged from 250 to 400 pounds.

Shock is a marked feature in certain types of intestinal obstruction, always being present in the early stages when the circulation is affected and always being a concomitant of toxemia in the late stages. Indeed, the toxemia of intestinal obstruction is now almost universally agreed to be allied with surgical shock. Shock is also always associated with the extreme distention present late in the condition, no matter what the primary cause has been.

Since intestinal obstruction is a condition which is not primarily inflammatory, elevations of temperature, as will be seen from Table I, are not usual in the early stages, though definitely or slightly subnormal tempera-

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tures are quite common. In this series the temperature range was from 94 to 105° F. Of the ninety patients who exhibited a temperature over 100°, 71.1 per cent. died, this being 30.6 per cent. of the total number of deaths. Of the 118 who exhibited a temperature below normal, 72.8 per cent. died, this being 41.1 per cent. of the total number of deaths. That is, roughly 71 per cent. of the patients who died exhibited a temperature below normal or over 100 degrees.

TABLE I.  
*Temperature Range on Admission.*

Temperature	Number cases	Per cent.
Below normal .....	118	34.4
To 100 .....	135	39.4
To 102 .....	72	21.0
Over 102 .....	18	5.2

Elevations of the pulse rate are quite usual, and, in conjunction with a subnormal or normal temperature, offer valuable diagnostic aid. In this series the pulse range was from 50 to 180 (Table II), the rate in many instances being so rapid that counting was not possible. Of the 153 patients with a rate over 100, 70 per cent. died, 50.2 per cent. of the total number of deaths.

TABLE II.  
*Pulse Range on Admission.*

Pulse rate	Number cases	Per cent.
Below 70 .....	8	2.3
Normal (70-84) .....	82	23.7
To 100 .....	100	29.3
To 120 .....	78	22.7
Over 120 .....	75	21.9

Practically all of the forty-two white counts in the series which were over 12,000 (the range being to 35,000), were in the group of strangulated or circulatory obstructions. The chemical changes included principally a fall in the blood chlorides and a rise in the CO<sub>2</sub> combining power of the blood. In one instance the latter reached the extraordinary figure of 113, the patient recovering after a very stormy convalescence. The rise in the non-protein blood nitrogen is quite constant in these cases, and in moribund patients, particularly if an accurate history cannot be secured, it may lead to a mistaken diagnosis of uremia.

The last few years have witnessed extensive and valuable work, both experimental and clinical, on the chemistry of intestinal obstruction, and the work of Whipple, Stone, Scholefield, Hermann, Gatch, Trusler and Ayres, to mention only a few of the many investigators, has been of inestimable aid in establishing the proper pre-operative and post-operative treatment and in confirming the necessity for prompt operation. On the other hand, the true nature of the toxin produced has not been identified, and the

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results of the experimental work have often been contradictory, largely because it has not been based on the same premises. Without depreciating in any way the immense value of this work, I would echo Hertzler's warning, that in our zeal for chemical investigation we must not forget that after all our main concern is with the damaged bowel wall which is the primary source of the trouble.

With such a confusing array of symptoms and signs, how is a diagnosis to be made? Of chief importance is the securing of a careful history, particularly with reference to the symptoms of the attack and their relation to each other. Special emphasis should be laid on the character of the pain, for that is the chief diagnostic sign. Moynihan says that it is safe to say that any acute abdominal pain not promptly relieved by a small dose of morphia—which, by the way, should be a remedy and not a refuge—will require operation, and other writers emphasize the fact that any abdominal pain which lasts more than six hours in a previously well patient justifies an exploratory operation. It cannot be too strongly stressed, in this connection, that mere subsidence of the pain may in itself be a most misleading thing; the patient's well-being may arise not from a disappearance of the pathology but from the development of gangrene.

Next in importance is a careful physical examination, and Deaver, at this point, urges the importance of auscultation, either with the naked ear or with the stethoscope, mentioning the "ominously silent abdomen" of the late stages of the condition, in which the pulsation of the aorta is the only sound. It is frequently urged that constipation may be elicited as a symptom by the giving of two enemata, the first to empty the lower bowel, the second to demonstrate the obstruction. This is all very well if the lower bowel is implicated, but if the obstruction is high the method does not serve the purpose, and it is always time-consuming. Codman advises digital rectal examination and describes the empty rectum in which the walls crowd around the finger, while above is a sensation of tremendous intraabdominal pressure.

There is no time for a fine-spun laboratory diagnosis. Naturally a routine urinalysis is imperative, and a blood count will do no harm, though it is seldom of particular value. Blood chemistry is a prognostic and therapeutic aid, not a diagnostic measure chiefly, and with our present methods the procedure is still so complicated that time should not be wasted in securing the data. As for X-ray examinations, they are of little value without the administration of barium, and a barium meal, as I see it, has not the smallest justification in the face of even a suspicion of intestinal obstruction. I have in my day operated on patients for intestinal conditions who had just previously been given barium and I have no desire to repeat the experience.

In short, in this condition, operation is justified on mere suspicion. The important thing is to suspect, of course with reason, that intestinal obstruction exists, not to make a brilliantly detailed diagnosis. Speedy operation is the more warranted because practically all conditions which may be confused with it are amenable only to surgical treatment, and if cardiac, pul-

monary and renal disease are eliminated, then exploration is always less harmful than delay. The best authorities are agreed on this point. C. H. Mayo says that he has never seen a patient die as the result of an unnecessary exploratory incision, though he has many times seen death occur because it was made too late, and Finney suggests that it would be better to do "a few unnecessary exploratory operations on live patients than to continue the long and melancholly roll of hurried enterostomies on moribund patients".

Cope and Souttar are agreed that herniæ are the most frequent cause of intestinal obstruction, with intussusception, malignancy and adhesions or bands next in order. In my own series the order (Table III) is slightly different. As a rule, the commonest cause in childhood is intussusception, while in advanced adult life malignancy and herniæ are responsible for most cases. The small bowel is more likely to be involved than the large. In this series it was involved alone in 57.2 per cent. of the cases, and with the cecum (chiefly in intussusception) in 19.7 per cent., while the colon was involved in 17 per cent. and the sigmoid in 6.1 per cent.

TABLE III.  
*Cause of Obstruction.*

Pathology	Number cases	Per cent.	Mortality
Herniæ .....	96	28.0	61.5
Adhesions .....	68	19.8	58.8
Intussusception .....	42	12.2	52.4
Volvulus .....	34	9.9	58.8
Bands .....	30	8.7	56.6
Carcinoma .....	17	4.9	88.2
Thrombosis .....	7	2.0	71.4
Concretions .....	3	.9	66.6
Miscellaneous .....	19	5.6	52.6
Unidentified .....	26	7.9	84.6

The higher the obstruction the more quickly do symptoms develop, the more rapid and more fatal is the toxin, the more serious is the outlook, and the greater is the necessity for prompt surgical intervention. In the large bowel, on the other hand, while bacteria are more numerous, the production of the fatal toxin is less swift and the prognosis would undoubtedly be more favorable except for the fact that the majority of the obstructions of the lower bowel are due to malignancy of long-standing, so that the patient's condition is bad to begin with. In the chronic cases which have become acute the prognosis is better than in the immediately acute type, partly because a certain degree of intestinal immunity has been established, partly because long-standing distention has resulted in a sort of compensatory hypertrophy of the bowel.

Table IV, which gives the mortality for the various types of pathology found in this series, also gives the comparative mortality for Souttar's and Tuttle's studies, though, because of differences in classification, the comparison is necessarily incomplete. It should be said that the very high mortality



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for carcinoma in my own series is due largely to the fact that several of the Charity Hospital patients recovered from their operations but remained in the hospital until death (in one instance this occurred fifteen months later) because they could not be cared for elsewhere. Otherwise the mortality would probably be considerably lower.

TABLE IV.  
*Comparative Mortality.*

Pathology	Miller	Souttar	Tuttle
Concretions .....	66.6	50.0	100.0
Carcinoma .....	88.2	43.5	42.9
Adhesions .....	58.8	31.0	33.3
Bands* .....	56.6	33.0	55.6
Intussusception .....	52.4	22.0	71.4
		35.0	
Volvulus .....	58.8	51.0	40.0
Herniæ .....	61.5	16.0	32.4
		20.0	
		35.0	

The duration of the illness, as we have already emphasized, is the clue to the mortality in the vast majority of cases, but it is extremely difficult, particularly with ignorant patients, to secure the duration accurately. This is the explanation, I believe, of the very high mortality in the present series for the first twelve hours (Table V), 29.4 per cent. being decidedly in excess of the 13 per cent. reported by Bowers, the 4 per cent. reported by Tuttle, and the 5 per cent. reported by Finney. In nearly all of the studies of which I have knowledge it is agreed that after the third day the mortality is rarely less than 50 or 60 per cent.

TABLE V.  
*Mortality Based on Duration of Symptoms.*

Duration	Mortality	Duration	Mortality
Under 12 hours.....	29.4	Under 72 hours.....	63.4
Under 24 hours.....	52.9	Under 96 hours.....	72.8
Under 36 hours.....	50.0	Over 96 hours.....	84.0
Under 48 hours.....	59.6		

For working purposes Sir William Taylor's classification of cases, based on the condition of the patient, is an excellent one. In the first group the patient is seen early and is in good condition, so that simple relief of the obstruction, plus routine pre-operative and post-operative treatment, will suffice for a cure. In the second group he is seen somewhat later, his condition is still fairly good, but because toxemia is an actual or potential factor, drainage of the bowel is instituted in addition to the relief of the obstruction. In the third group he is seen late, his condition is poor, toxemia is at least as important a factor as the primary obstruction, and only drainage of the bowel by jejunostomy is warranted. If the patient survives—as he usually

\* Probably inaccurate.

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does not—the necessary procedures for the relief of the obstruction are done later. That is, the condition of the patient must determine the type of procedure, and for that reason the figures of Table VI are not necessarily an interpretation of the value of any special operation.

TABLE VI.  
*Mortality in Relation to Procedure.*

Procedure	Number cases	Per cent. cases	Mortality
Release obstruction.....	86	25.1	40.7
with drainage*.....	30	34.9	56.6
Drainage only*.....	72	21.0	87.5
Resection .....	54	15.7	76.0
immediate anastomosis	44	80.8	73.8
Reduction† .....	49	14.3	32.7
with drainage*.....	6	12.2	50.0
Invagination .....	12	3.5	97.5
Herniotomy (only).....	52	15.2	57.7
Miscellaneous .....	18	5.2	66.6

Many observers believe that once distention and toxemia have set in only resection can save the patient. Certainly in this study resection of the bowel, even when immediate anastomosis was done, which is admittedly unwise in most instances, makes a better showing with a mortality of 73.8 per cent. than does the apparently conservative treatment of gangrenous or merely suspicious areas of the bowel wall by invagination or plication, with a mortality of 97.5 per cent. The high mortality in simple drainage of the bowel, 87.5 per cent., is after all no argument against this procedure, for it was usually employed only in those cases which were frankly hopeless from the start. The high mortality for simple herniotomy (without operation on the bowel), 57.7 per cent., is undoubtedly due to unsuspected damage of the bowel wall, and suggests that conservatism in this particular connection is rather more dangerous than apparent radicalism.

TABLE VII.  
*Comparative Mortality in Relation to Procedure.*

Procedure	Miller	Richardson	Perthes‡	Tuttle
Herniotomy .....	57.7			25.5
Drainage of bowel .....	87.5			76.0
Resection .....	76.0	53.3		68.4
with drainage of bowel	73.8		56.0	
Reduction .....	32.7			20.0
Relief obstruction only.....	40.7	34.1	21.0	
with drainage of bowel	56.6		56.0	

The important fact which emerges from a study of these statistics and from those of Tuttle, Scholefield and Richardson (Table VII) is that the

\* Of bowel.

† Of volvulus or intussusception.

‡ Quoted by Scholefield.

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success of any procedure is based on its relation not only to the pathology present but to the condition of the patient. There is small point to doing a perfect operation if the patient dies on the table, as happened five times in this series. The experienced surgeon is content merely to save life, even if he does not complete his surgery; it is the tyro who must finish the job. As Horsley says, "There is such a thing as the surgeon being intoxicated with his own dexterity, so that on some occasions it overbalances his surgical judgment". Codman is right when he says that success depends more on the surgeon's mental than on his manual processes, and that surgical judgment consists in "applying a knowledge of possible expedients to a knowledge of possible pathologic combinations". To put it more colloquially, this is one condition in which Murphy's advice, "to get in quick and get out quicker", should be followed to the letter, and in which, as Bunnell says, "every manipulation is a shove nearer the grave", which latter observation holds quite as true of necessary as of unnecessary procedures.

Such matters as the location of the obstruction, the management of the distended intestines, preliminary drainage of the bowel and similar points of detail have no place in a general paper of this sort, though I cannot omit the caution that never should a gangrenous bowel, whether drained or undrained, be left within the cavity. Certain specific procedures, however, must be briefly mentioned. The short-circuiting operation suggested by Sampson Handley is a very valuable method in those instances in which the state of the bowel is uncertain or in which the patient, because of age or weakness, could not tolerate an extensive resection. On the other hand, it is time-consuming, so that it could not be used on patients in bad condition; the anastomosis is within the abdomen and the bowel is not therefore available for lavage, drainage or nutrition; and finally, the jejunocolostomy as specifically advocated by Sampson Handley means, as pointed out by the late Dr. Parham, that the jejunal contents are returned to the colon before appreciable digestion and nutrient absorption have taken place. Enterostomy is clearly indicated in all cases in which toxemia is a factor, and Whipple pays tribute to its efficacy when he says that it has reduced the mortality at the Presbyterian Hospital by 13.2 per cent. Its advantages are evident, and the chief disadvantage, the loss of digestive fluids, is minimized by the employment of the Witzel technic, which also provides against a possible fistula and a later tedious closure. Cecostomy should be a routine procedure in malignancy of the large bowel, no matter what surgery is done. The two-stage operation is generally preferable in this condition unless the patient is unusually well fitted to withstand extensive surgery, but immediate anastomosis is almost essential when the small intestine is so involved that resection is necessary, because of the loss of digestive fluids. Wilkie's method, which was discovered accidentally, has considerable to commend it, the fluid from an upper enterostomy being allowed to flow back into the intestines through the tube of a lower enterostomy.

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These, however, are all matters of specific performance. The success of surgery in intestinal obstruction is based, not upon the actual procedure adopted, providing that it stops the formation and absorption of the toxin, relieves the distention and establishes the fecal flow, but rather upon the adaptation of that procedure to the conditions present in the individual case.

It must be remembered that such pathology as intussusception and volvulus is prone to recur, and that, if the patient's condition warrants it, the faulty anatomy which is responsible for them should be rectified at the time of operation. This was vividly illustrated by a case in the present series in which, within a year, the volvulus recurred twice; the third operation terminated fatally.

It is an almost universal belief that spinal and local analgesia are to be preferred to general anaesthesia, or at least to ether anaesthesia, in all cases of intestinal obstruction because of the patient's state of shock, the blood changes, the inhibition of intestinal peristalsis, and possible post-operative vomiting. In selected cases I have no doubt that this is true, but I have long questioned the practical results of a general application of this reasoning, and this series, as will be apparent from Table VIII, quite sustains my point.

TABLE VIII.  
*Mortality in Relation to Anaesthesia.*

Type	Number cases	Per cent. cases	Mortality
None .....	1	.3	100.0
Local .....	110	32.1	78.2
Spinal .....	33	9.6	69.7
General .....	199	58.0	50.3

It is more than mere coincidence that the mortality for local analgesia should be 20 per cent. higher and the mortality for spinal analgesia should be 10 per cent. higher than the gross mortality of the whole series. It is more than mere coincidence that the mortality for local analgesia should be roughly 30 per cent. higher and the mortality for spinal analgesia roughly 20 per cent. higher than the mortality for general anaesthesia, in spite of the fact that ether, admittedly the least auspicious of the general anaesthetics, was most frequently employed. It is more than mere coincidence that the hospital which used general anaesthesia in less than 45 per cent. of its cases should have a mortality 15 per cent. higher than the hospital which used it in 91 per cent. of its cases.

Also the figures of Table IX are more than mere coincidence. Fifty-seven surgeons did the 343 cases represented in this series, five men described as A, B, C, D and E doing the greatest number. It is more than mere coincidence, I say, that the man who used the greatest amount of general anaesthesia, 57 per cent., should have the lowest mortality, 46 per cent., while the men who used the smallest amounts, 30 per cent., 25 per cent. and 29

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per cent. respectively, should have the highest mortalities, 83.7 per cent., 66.6 per cent., and 70 per cent.

TABLE IX.

*Mortality in Relation to Anæsthesia and Surgeons.*

Surgeon	Per cent. general	Mortality	Number cases done
A .....	30.0	83.7	42
B .....	25.0	70.0	40
C .....	57.0	46.0	37
D .....	42.0	66.6	33
E .....	29.0	66.6	24

It is more than mere coincidence, as shown by Table X, that the duration of the operation should be on the average twenty-eight minutes more for local and twenty-seven minutes more for spinal analgesia than it was for general anæsthesia. A study of these particular figures in relation to deaths and cures is even more striking.

TABLE X.

*Mortality in Relation to Anæsthesia and Length of Operation.*

Type	Duration cures— minutes	Duration deaths— minutes	Average duration— minutes
Local .....	85	85	85
Spinal .....	76	95	84
General .....	52	62	57*

These things, as I say, without meaning invidious comparisons between hospital and hospital and surgeon and surgeon, are more than mere coincidence. Prolongation of the procedure and the excessive manipulations inevitable when either spinal or local analgesia is employed are bound to exert a deleterious effect in a condition where speed and gentleness are essential, and are bound, in the end, to be worse for the patient than the results of a skilfully given anæsthetic, even when, because of the limitation of circumstances, that anæsthetic must be ether.

Moreover, as is shown by Table XI, neither local nor spinal analgesia prolongs life or defers death. Only 27.6 per cent. of the patients who

TABLE XI.

*Mortality in Relation to Anæsthesia and Time of Death.*

Time of death	Local	Spinal	General	Total
Table to 12 hours.....	31.4	39.1	31.0	32.0
Within 24 hours .....	46.5	65.2	49.0	49.8
After third day .....	33.7	8.7	27.0	27.6

eventually died lived beyond the third day, but only 8.7 per cent. of those who had had spinal analgesia lived beyond that time. Within the first twelve hours after operation 32 per cent. of these patients died; the figures for local analgesia and general anæsthesia are practically the same, but the figures

\* Markedly increased by fact that one patient was on table four hours.



for spinal analgesia are considerably higher. It is a frightful commentary on the deadliness of this condition and on the results of delayed surgery in it that within twelve hours after operation a third of the patients should be dead, and that only a fraction over half of them should survive at the end of twenty-four hours.

The comparative statistics of Table XII are given for what they are worth, though it is manifestly unfair to compare statistics based upon different premises, or to weigh the results of the composite work of a hospital, particularly of a public hospital, against the individual results of an expert surgeon. I think it is safe to say, however, that the higher the mortality is, the more nearly accurate it is likely to be, and that a mortality of 60 per cent. is more likely to be correct than a mortality of 30 per cent. or lower.

TABLE XII.\*  
*Comparative Mortality.*

Series	Mortality	Series	Mortality
Burgess .....	23.5	McGlannan .....	45.7
Codman .....	34.0	Miller .....	60.9
Deaver & Ross .....	42.0	Richardson .....	41.5
Finney .....	36.0	Scudder .....	60.0
Guy's Hospital.....	31.5	Short .....	41.0
Irwin .....	38.7	Tuttle .....	41.3
Lynch & Draper .....	25.0	Van Beuren & Smith.....	41.8

The exigencies of the case do not permit the rehabilitation, as we commonly understand the term, of the patient suffering from intestinal obstruction; but no matter how serious his condition, there are certain essential procedures which must never be omitted. In the first place, gastric lavage must be done and must be repeated until the fluid returns clear; otherwise, particularly if a general anæsthetic is administered and the glottic reflex is eliminated, the patient may drown in his own secretions. In the second place, normal saline solution must be given by hypodermoclysis or infusion, to restore the fluid balance and to replace the lost chlorides. After operation the treatment depends upon the necessities of the individual case, with the continued use of the stomach tube a most important factor. Blood chemistry now is essential as an index to treatment and saline solution or glucose and insulin should be employed according to the indications.

Prophylactic immunization before intestinal operation, as suggested by the results of the recent work of Hermann at the Mayo Clinic, is based on very logical reasoning, but at present, of course, is purely theoretical. This work, by the way, presents a strong argument for the two-stage resection, in that it seems to prove that the admittedly higher resistance of the patient at the second operation is due to the production of an active local peritoneal immunity by the soiling of the first operation.

\* Figures not to be accepted absolutely for comparison since they are based on different premises and include different types of cases.

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The recent work of B. W. Williams with anti-gas serum, both post-operatively and as a prophylactic pre-operative measure, should also be mentioned. It is based on the theory that the severe toxemia of intestinal obstruction is due to the presence of the toxins of *B. Welchii* in the fecal contents above the obstruction. It cannot be denied that the symptoms of the terminal stages, at least, do suggest those of gas gangrene and, while this method is still in the experimental stage, it seems to have decided possibilities.

Certain minor considerations in this study may be of interest. Tuttle and Finney both report intestinal obstruction as somewhat more frequent in the colored than in the white race, and my own figures bear them out. At Charity Hospital (Touro does not admit colored patients) 50.8 per cent. of the cases were colored, although the relation of colored and white in the general hospital admissions for the last five years was only 44.7 to 55.3. In the entire series 63.6 per cent. of the patients were white, and the mortality for the two races was practically identical, 61 per cent. for the white and 60.8 per cent. for the colored.

One hundred ninety-one patients were male, 55.7 per cent. of the total number, and the mortality among them was 57.6 per cent., as compared with a mortality of 65.1 per cent. among the females. In both Tuttle's and Finney's series the proportion of male to female was decidedly higher than in my own series. Also Finney's theory, that the preponderance of cases in the colored race is due to the prevalence of inflammatory disease of the female pelvis, is not borne out in this study, since only 28.8 per cent. of the colored patients were women, a ratio of less than three to seven.

The ages ranged from thirteen days to ninety-two years, with nearly half of the patients between twenty and fifty. Thirty-two and four-tenths per cent. were over fifty, and I believe that this offers at least a partial explanation of the unusually high mortality for hernia in this series, since a very great number of these cases occurred in individuals over seventy, who often exhibited cardiac or renal disease in addition to the intestinal condition.

Two hundred forty-six cases, 71.7 per cent., were treated at Charity Hospital, with a mortality of 65 per cent. Twenty-eight and three-tenths per cent. were treated at Touro Infirmary, with a mortality of 50.5 per cent. The fact that Charity Hospital is a public institution which draws its population from the ignorant and indigent and from rural as well as urban districts, is undoubtedly the chief explanation of the higher mortality there, but even at that the Touro record would seem to indicate that comparative affluence and social station are no guarantee to early diagnosis and prompt treatment in intestinal obstruction.

The sixteen medical cases studied along with the surgical series resulted in a hospital mortality of 87.5 per cent. Six of these patients refused operation, and two of them were removed from the institution when nearly moribund, which explains why the hospital mortality was not 100 per cent. The duration of the illness ranged from twenty-four hours in one case to more

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than seventy-two hours in eight. In two instances the diagnosis was confirmed by post-mortem, but the clinical picture was beyond dispute in all of the others, and the mere recital of the facts is a sufficient commentary on the melancholy story.

Codman, in a brief historical survey, points out that the pioneer work in intestinal obstruction was done by Fitz in 1888. At that time he collected from the literature for the preceding eight years 295 surgical and non-surgical cases, with a mortality of 69 per cent. At the Congress of American Physicians and Surgeons at which he presented his report, and at which the subject was also discussed by Senn, it was agreed that two days should be the limit of medical treatment and that after that period surgery should be considered inevitable. Our mortality today is sufficient evidence that even though our theories are different, our actions for the most part follow the plan laid down by our forefathers.

### CONCLUSIONS

1. The mortality of intestinal obstruction, while usually stated to be between 30 and 40 per cent., actually ranges between 55 and 65 per cent.
2. The chief explanation of this mortality is delay in diagnosis and treatment, and patient, medical man and surgeon are all responsible for it.
3. Intestinal obstruction has three phases, the mechanical obstruction with stoppage of the fecal current, the damage of the bowel wall with ultimate gangrene, and the production of toxins.
4. The three principal symptoms are abdominal pain, vomiting, and complete constipation, but any of these may be lacking in any case.
5. A detailed diagnosis is not essential and the seriousness of the condition warrants exploration on mere suspicion.
6. The condition of the patient rather than the procedure chosen determines the result of surgery, and it is better, generally speaking, to do too little than too much.
7. In spite of the general belief to the contrary, this series proves that from every standpoint the results are better when general anæsthesia, even ether, is employed in preference to local or spinal analgesia.
8. The principal fact which emerges from this analysis of 343 surgical cases of intestinal obstruction is that prompt operation offers the only means by which the mortality of the condition can be brought within reasonable limits.

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## A CONTRIBUTION TO THE MECHANISM OF FRACTURES AND DISLOCATIONS IN THE ELBOW REGION\*

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THE most important unexplained fact associated with the mechanism of fractures and dislocations is typical deformity, *i.e.*, the tendency of the fragments in each common fracture or dislocation to occupy a typical or usual position or deformity. Fractures of the upper extremities occur most frequently and their deformities are most typical near the large joints. As the writer sees them, dislocations are merely fractures of the skeleton at the joints with displacement of the fragments and increase the total number of fractures of the skeleton in and near the joints. It follows, therefore, that typical deformity offers its best opportunities for study near the joints. We have three large joints in the upper extremity—wrist, elbow and shoulder—where these injuries of the skeleton are common. They are most common in the wrist region where the fall on the hand is established as the cause of the typical deformity, *i.e.*, the lower fragment is displaced backward and usually to the radial side, the upper fragment forward. The most typical fractures here usually involve the bones above the wrist-joint, the radius alone or radius and ulna, rarely the carpal bones. The writer has given much attention to hyper-abduction as the basic factor in the mechanism of fractures and dislocations in the shoulder region and as the end result at the shoulder of the effect of the fall on the hand. He has long deferred an attempt to discuss the influence of the fall on the hand in the mechanism of fractures and dislocations in the elbow region because of the special difficulties associated.

The fall on the hand has found some support in the explanation of fractures about the elbow-joint, but its influence has been invoked especially to account for posterior dislocations here. The theory has long prevailed that it tends to produce hyperextension and thus posterior dislocations of this joint. Stimson tells us that there have been offered a theory of flexion, a theory of direct displacement backward, a theory of distortion, and a theory of hyperextension and abduction. He says that it is now generally believed that the injury is habitually caused by a fall on the palm of the outstretched hand, the elbow being in complete extension and that the primary rupture of the ligaments which makes the dislocation possible is effected by hyperextension of the joint. He also says that "the mechanism or mode of production has been the subject of much controversy, largely due to the resort to hypotheses which was stimulated by the lack of definite knowledge. Few who fall are able to describe the circumstances of the fall, to say whether the arm was fully extended or partly flexed, whether the violence was received upon the hand or upon the elbow, and a preconceived theory in the mind of the surgeon is a great help to the discovery of the facts that favor it."

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\* Read before the Philadelphia Academy of Surgery, October 1, 1928.



## ELBOW FRACTURES AND DISLOCATIONS

The writer has produced many dislocations of the elbow in the cadaver by hyperextension and has not yet produced one by any other mechanism, but this is far from proving that they are thus produced in life. The cadaver experiments upon which the theory of hyperextension is largely established were based upon the hypothesis that the force of the fall on the hand compels and tends to exaggerate extension of the elbow. About twenty-five years ago the writer \* made an observation in connection with experimental work on the cadaver that interfered in his mind materially with the theory of hyperextension from the fall on the hand. He repeated the experiments of von Bruns † on the cadaver for the production of typical fractures of the head of the radius. The arm was disarticulated at the shoulder-joint, the palm placed on the ground, by the left hand the arm was held almost upright in rigid extension at the elbow, while heavy blows with a mallet in the right hand were struck on the top of the humerus until the anterior third or half of the radial head was split off vertically. Von Bruns assumed that he was thus reproducing the force of the ordinary fall on the palm of the hand. The writer believes that this assumption was correct. Probably no one has disputed it and probably no one has produced another typical fracture on the cadaver by the force of the fall on the hand. The writer obtained six typical fractures of the radial head by von Bruns' method. The vital point in this discussion depends upon whether von Bruns correctly assumed that he was reproducing the mechanism of the fall on the hand in his experiments, because if he did then it should be a simple matter to demonstrate, without hypothesis, the effect of the force of the fall on the hand upon extension or flexion of the elbow. Each fracture of the radial head obtained by the writer required many blows of the mallet on the top of the humerus and practically every blow was made with full strength of the striking arm. It was early realized that the left hand holding the cadaver humerus and arm upright was being strained uncomfortably from its effort to maintain the limb in extension at the elbow against the tendency of each blow to flex it. Efforts were made to so force the elbow into extension by the left hand that this flexion would be prevented, but the flexion or strain toward flexion always occurred. It was clear that the force of the flexion varied with the force of the blow on the top of the humerus. Because it required so many blows to produce each fracture of the radial head an attempt was made to produce the fracture by one blow. A heavy iron bar was used as a substitute for a sledge hammer, the writer holding the humerus and arm upright with both hands while an assistant struck the heavy blow on the top of the humerus. The thought had been entertained that the flexion of the elbow might be prevented when both hands were used to hold the arm upright. The violence of the flexion of the elbow following this heavy blow was so great that this experiment was not repeated. These observations on the cadaver left no doubt in the mind of the writer that the fall on the palm of the hand in life produced flexion of the elbow when the force was great enough to over-

\* University of Pennsylvania Medical Bulletin, October, 1905.

† Centralblatt f. chir., vol. vii, p. 353, 1880.

come the power of the muscle contraction to prevent it, as when a gymnast turns a somersault with the aid of his hands. A light blow will scarcely demonstrate the flexion. There is nothing hypothetical about these observations and they can be confirmed or refuted by any one who cares to make the effort. A sufficient test would be the production of an experimental fracture of the radial head. This requires that the arm be disarticulated at the shoulder-joint,

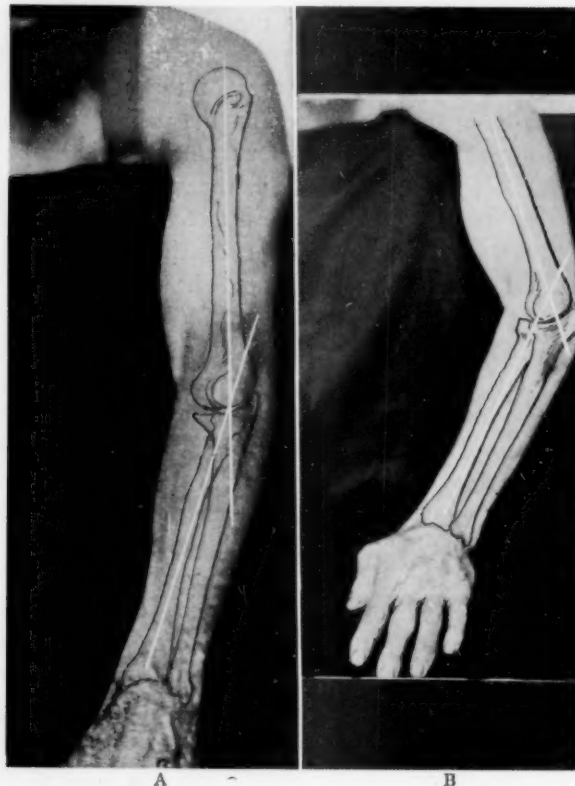


FIG. 1.—Left upper extremity in common attitude of fall on palm of hand. Upward thrust of forearm exerted chiefly through radius because it practically alone articulates with hand. In supracondylar fracture of humerus and dislocation of elbow the lower fragment is almost always pushed upward and backward behind the upper fragment as indicated by the radicle line of resistance which crossed and passes behind the humeral line of force produced by the falling body, even in A in which the elbow is in full extension. This tendency is increased with increasing flexion as shown in B.

the palm placed on the ground, the arm held upright and rigidly straight at the elbow-joint by the left hand, while successive heavy blows are struck on the top of the humerus by a heavy mallet in the right hand. The humeral head will probably be crushed, requiring that it be sawed off before a fracture is obtained and it will be necessary to continue the blows on the new top of the humerus. In all probability, before the radial fracture is obtained, the question as to the effect of the blows on the production of flexion of the elbow-joint will be settled. In the years since these observations were first made nothing has developed to change the writer's mind on the point involved, but it has been a problem how to proceed further in applying it to

the explanation of the mechanism of fractures and dislocations in the elbow region. It has not been considered important enough to go into the complicated question of why the elbow flexes from the fall on the hand but quite enough to know that it does. Evidently the anatomy of the skeleton at the elbow-joint is such that the force applied compels flexion.

One can deduce how the line of force coming down the rigidly-straight upper extremity and the line of resistance coming up from the hand on the ground meet and break the radius near the wrist-joint, the fragments being carried by the remaining force into their typical displacement, but it is a

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more difficult matter to imagine how these forces act at the elbow in the presence of the complicating flexion. At the moment of impact on the palm the forearm is usually in pronation, the elbow is in extension and the posterior surface of the elbow presents postero-externally, *i.e.*, away from

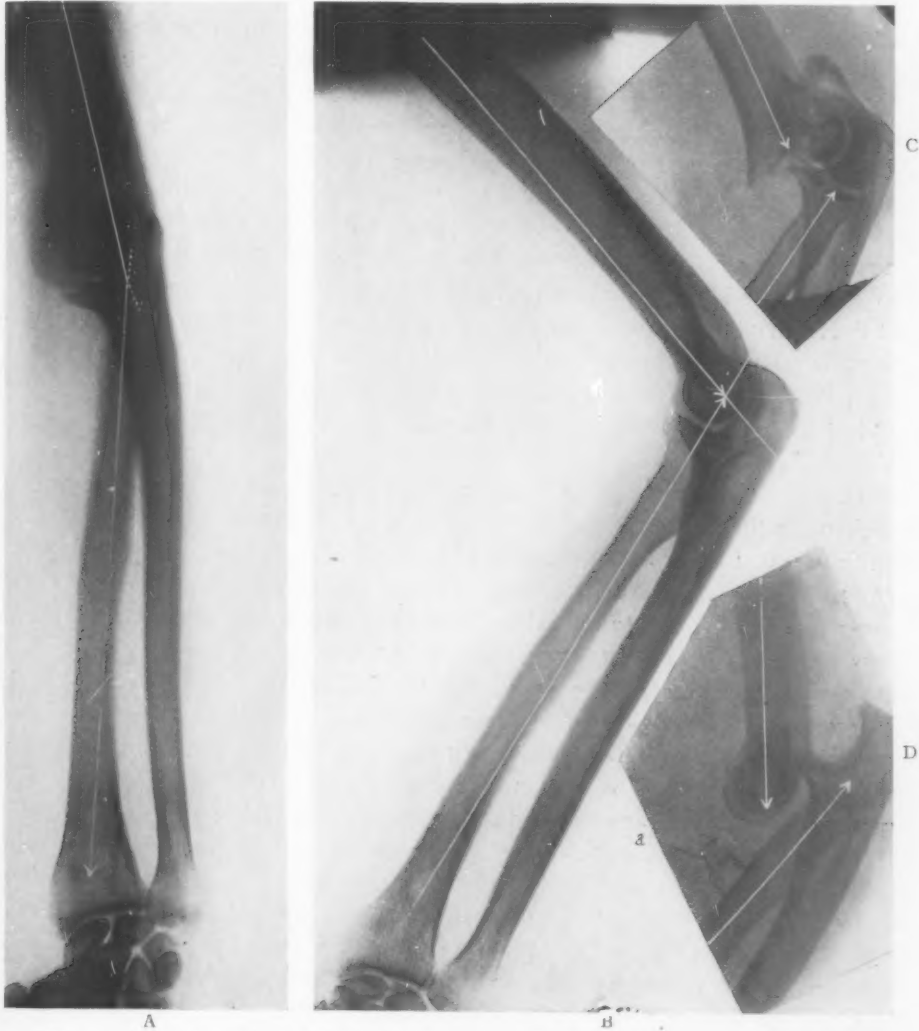


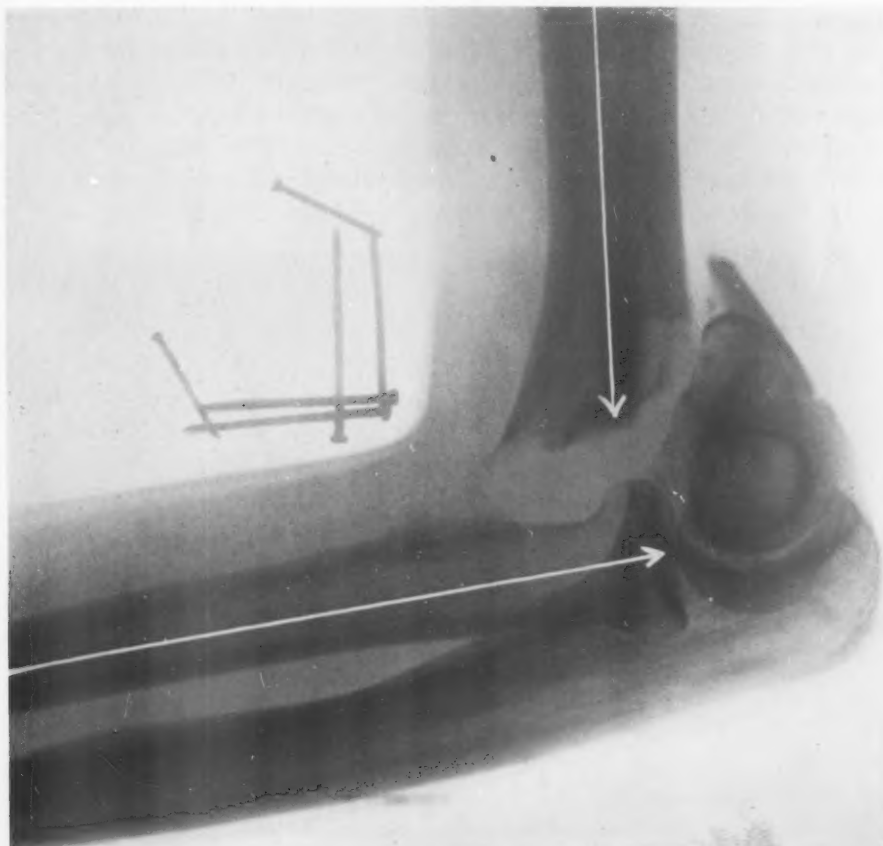
FIG. 2.—X-ray illustrations of the left upper extremity in the same positions as the arms shown in Fig. 1; A with the elbow in full extension and B with it in partial flexion. A suggests but B emphasizes more forcibly by comparison with C and D why supracondylar fracture of the humerus is more frequent than posterior dislocation of the elbow, and why mistakes in diagnosis between them were so common before the discovery of the X-ray. a shows the detached fragment of the radial head knocked off and pushed downward by the fracturing force exerted through the humerus.

the body and somewhat posteriorly. (See Fig. 1.) The line of the radius which receives the chief force from the impact in ascending the forearm passes from the radial side of the forearm at the wrist (which in pronation of the forearm corresponds to the anterior surface of the elbow) to the ulnar side of the forearm at the elbow (which corresponds to the posterior surface

of the elbow). The line of resistance from the impact of the palm on the ground, therefore, would pass upward and backward through the radius and out of the limb posteriorly at the elbow, thus tending to drive the radial head upward and backward behind the humerus. The ulna is strongly attached to the radius partly by the ligaments at the wrist and elbow but chiefly by the strong interosseous membrane, so that the force or resistance exerted primarily through the radius is readily transmitted to the ulna, so that both bones tend to be forced upward and backward together behind the humerus at the elbow, even while the elbow is in extension. But, as already stated, it is easy to prove by the above cadaver experiment that the effect of the impact of the palm on the ground is to compel immediate secondary flexion of the elbow which then strikes the ground with the remaining unspent force. The tendency of the ground resistance acting through the radius and ulna to force these bones upward and backward behind the humerus at the elbow, at the moment of impact of the palm on the ground, is increased with increasing flexion of the elbow. We thus see how the flexion of the elbow favors the posterior displacement of the radius and ulna at this joint in a dislocation and of the lower fragment in a supracondylar fracture of the humerus. (See Fig. 2, A, B, C, and D.)

Two varieties of force can thus be seen acting to produce injuries of the skeleton in the elbow region; first, that received from the impact of the palm on the ground and continuing during the secondary flexion, and second, that from the striking of the elbow and forearm on the ground. The writer has never found it feasible to reproduce these forces on the cadaver with sufficient success to obtain any typical fracture or dislocation except the above-mentioned fractures of the radial head. He has tried, however, through X-ray and clinical evidence to trace a possible relationship between these two forces and their effects, as shown by some of the typical fractures and dislocations in the elbow region. The only injury to the skeleton in the upper extremity generally accredited to the fall on the hand is the Colles's fracture, but the writer has not found that this mechanism has ever been proved for Colles's fracture by anybody nor that any one has tried to prove it. It has merely been generally asserted and generally accepted. It probably cannot be proved except by the fact that the force of the fall on the hand can explain every phase of the typical deformity and no other force can. If that kind of evidence has been sufficient to establish the fall on the hand as the common cause of the Colles's fracture, then it should be sufficient for establishing this cause for other fractures and dislocations. Again, in the fall on the hand the main force should be exerted at the moment of the first impact, while the elbow is in extension and to a lessened degree in the immediately following flexion. The secondary striking of the elbow on the ground should do less damage because by that time much of the original force should have been spent. If this can be shown by clinical evidence to be the fact, it might be considered confirmatory evidence that the fall on the hand is the usual cause of fractures and dislocations in the elbow region. Because

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A



B

FIG. 3.—A typical supracondylar fracture of the humerus, A, and a posterior dislocation of the elbow, B, in a more familiar position than those shown in Fig. 2, C and D. Note that the same portion of the head of the radius has been detached as in Fig. 2, D, but not displaced as far downward. This is the lateral view of the same dislocation as shown in Fig. 5, B.



"few who fall are able to describe the circumstances of the fall," we cannot hope to prove the mechanism of a fracture or dislocation from the history. But the X-ray tells us positively the character of the deformity when any is present, so that we must work backward and determine the cause from the effect.

It is not intended here to offer a complete explanation of the mechanism of the various solutions of continuity in the skeleton in the region of the

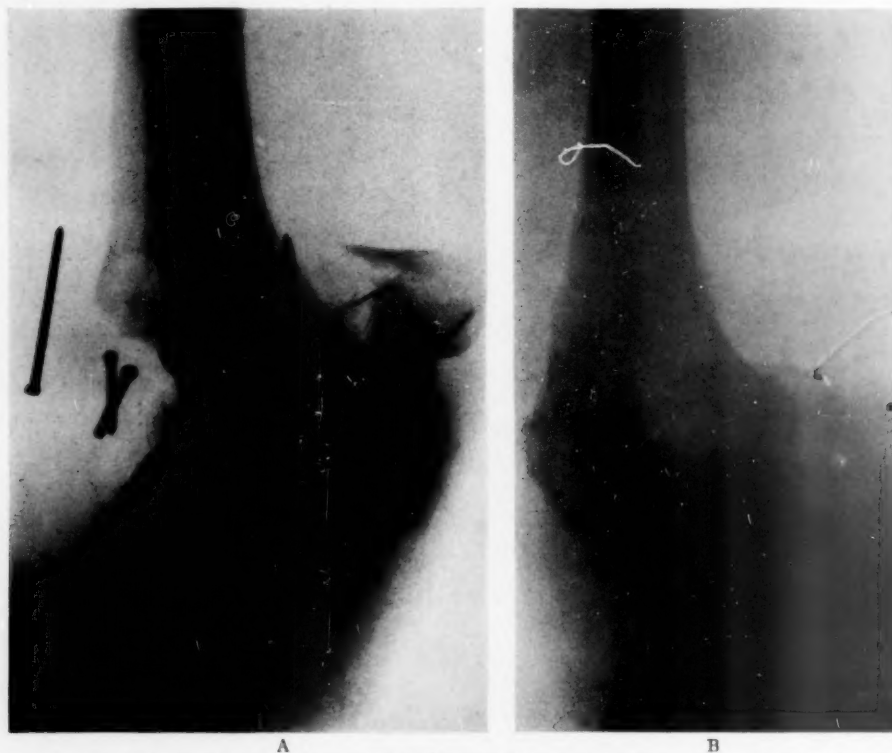


FIG. 4.—The most frequent fracture of the humerus here and the most frequent dislocation, not uncommonly show a posteroexternal or a posteroexternal displacement of the lower fragment, which is also typical of the Colles fracture. Muscle pull is usually invoked to explain the posterior and upward displacement in the fracture but never in the dislocation, and is never called upon to explain the inward or outward displacement in either. The fall on the hand will explain every phase of these common displacements in both injuries at the elbow as in the typical Colles fracture. The inward displacement in A was associated with a typical posterior and upward displacement and that in B with a posterior dislocation of the elbow joint.

elbow-joint. The whole field is too obscure, but it is hoped that what is offered may be entitled to consideration. The tendency has been to treat fractures and dislocations as separate entities. The writer prefers to discuss the fractures and dislocations of a given region, as the elbow region, together, because he believes that they are generally due to the same force and mechanism, the skeleton giving way where it can least resist the force applied. The particular site at which the break occurs varies probably with variations in the different skeletons and in the manner in which the force exerts itself. Fractures occur most frequently near joints probably because of the effect of the joint motion in transmitting the force. Fractures are much more

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common than dislocations probably because the direction of the fracturing force drives one bone directly against the other in such a way that they cannot pass by each other into the dislocated position without breaking off some obstructing portion of bone. This explains why pure dislocations of the wrist-joint almost never occur. Most fractures at the wrist occur in the radius at or immediately above this joint, and most fractures at the elbow occur in the humerus at or immediately above the elbow-joint. The expanded

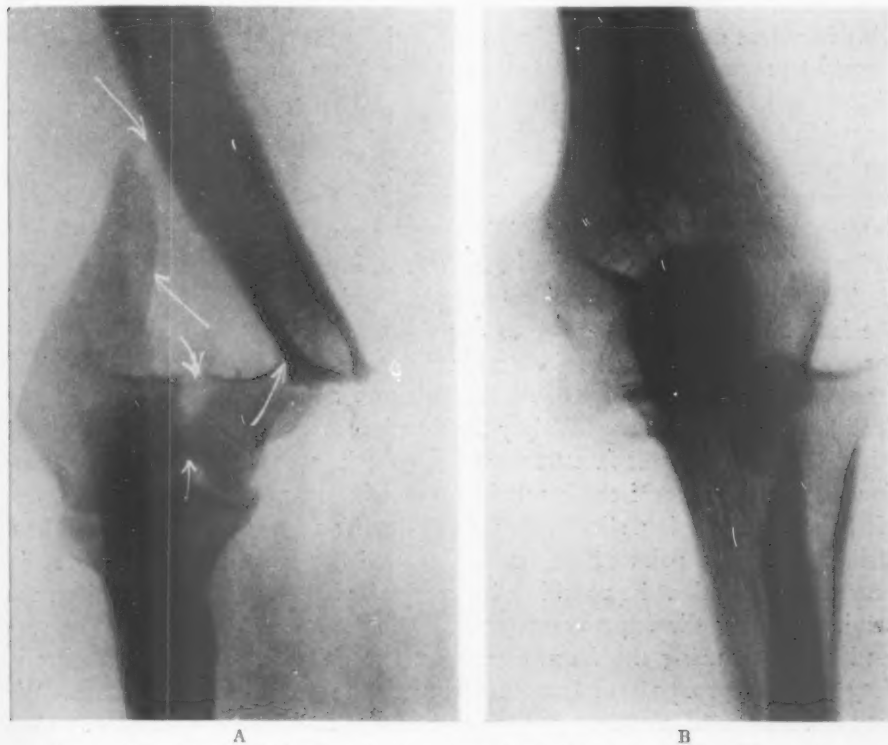


FIG. 5.—The external displacement in A was associated with the typical posterior and upward displacement of the lower fragment and the same displacement in B was associated with a posterior dislocation of the elbow (see Fig. 3 B), the two injuries occurring on opposite sides of the body.

cancellous radius is evidently less capable of resisting the force than the small and more compact carpal bones which are forced against it, and the expanded cancellous lower end of the humerus is weaker than the head of the radius and coronoid process of the ulna when they come together in the fall on the hand. In the Colles's fracture the lower fragment goes backward and upward and usually to the radial side, occasionally being displaced to the ulnar side, depending on whether the impact on the palm is received most on the thenar or hypothenar side. In the common fracture immediately above the elbow-joint, the lower fragment, as in the Colles's fracture, almost always goes upward and backward, but may go also to the radial or ulnar side, this probably depending largely upon whether the impact on the palm is received most on the thenar or hypothenar side. (See Figs. 4 and 5.)

Practically all fractures near the wrist, including those with dislocation of the wrist, show the same displacement of the fragments as the Colles's fracture, indicating that they are due to the same force, that of the fall on the hand. Most fractures of the lower end of the humerus and most dislocations of the elbow-joint have essentially the same deformities and these are not unlike that of the Colles's fracture, the lower fragment in nearly all of them passing upward and backward (see Fig. 2), and frequently to the radial or ulnar side. The dislocations of the elbow are frequently associated with fractures of the head of the radius and sometimes with fractures of the coronoid process of the ulna, but are probably much more frequently pure dislocations, *i.e.*, without associated fracture, than are dislocations of the wrist-joint. Like the dislocations of the wrist and Colles's fractures and like the lower fragment in a supracondylar or diacondylar fracture of the humerus, the common posterior dislocations of the elbow are sometimes associated with external or internal dislocation. We thus see a very close resemblance in the deformities of all these breaks of the skeleton in the wrist and elbow regions.

The assumption of flexion, not extension, of the elbow from the force of the fall on the hand permits one to theorize on the mechanism of some of the more common breaks of the skeleton in this region. It has been demonstrated conclusively on the cadaver that the common and typical fractures of the head of the radius are produced by the first impact of the palm on the ground while the elbow is still in extension. Lotzbeck, according to Stimson, produced five fractures of the coronoid process in ten attempts on the cadaver. He fixed the elbow in a slightly flexed position by a gypsum bandage and then, striking upon the palm of the hand, produced the fractures of the coronoid process. This might be considered a reversal of the force of the fall on the hand. Varying the experiment by extending the elbow completely he succeeded in producing the fracture only once. Stimson says this fracture is very rare except as a complication of posterior dislocation of the ulna. We may have a fracture of this process and of the radial head combined. (See Fig. 6.) According to Lotzbeck's experiments the coronoid process was broken off while the elbow was in some flexion, while Stimson infers from a thorough study of the literature that it occurs almost always as a complication of dislocation of the ulna backward. If both are right we should infer that flexion of the elbow plays a very important part in the mechanism of posterior dislocation of the elbow-joint, *i.e.*, of the ulna and radius together almost always. The fractures of the coronoid process are probably very rare and usually affect the tip only, as Stimson suggests. Such fractures can be shown only by a lateral X-ray exposure and then they are usually covered by the shadow of the radial head (see Fig. 2), so that they can be easily overlooked.

In the fall on the palm, at the moment of impact with the elbow in extension, the force is received at the elbow only by the anterior half of the radial head (which is the portion commonly broken off) and by the coronoid process. (See Fig. 6.) When these two fractures occur it is seen that all bony resist-

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ance to the downward thrust of the humerus from the force of the fall is removed, and, therefore, all bony resistance to the upward and backward thrust of the radius and ulna into the position of the posterior dislocation of the elbow. But while both these two fractures have been found associated with these dislocations they have not been common. Fractures of the radial head alone with these dislocations have been very much more common, but



FIG. 6.—Typical fracture of head of radius with detachment of anterior portion and fracture of coronoid process of ulna. The detached fragment in each is slightly displaced downward, indicating that both were produced by the downward thrust of the humerus of the moment of impact of the palm on the ground, when the elbow was in full extension and the humeral condyles were resting on only the anterior portion of the radial head and the coronoid process. This downward displacement of the detached portion of the radial head is more marked in Fig. 2 D, and Fig. 3 B.

the dislocations without either fracture have seemed to be still more common. Why the dislocations occur without either fracture is probably connected in some way with the transmission of the force during the secondary flexion of the elbow-joint.

The most common fractures at the elbow are those through the condyles of the humerus, or immediately above, and almost always show posterior and upward displacement of the lower fragment which is frequently displaced also to the outer or inner side. The typical posterior displacement is favored by the direction of the fracturing force of the fall on the hand at the moment of impact, the immediately succeeding flexion

of the elbow increasing the tendency toward the posterior displacement. (See Figs. 1 and 2.) It is more easy to understand why this fracturing force does not permit dislocations at the wrist without fracture of the obstructing radius, than to see why it does permit posterior dislocation of the elbow without fracture of the obstructing humerus. The fracture, however, is the rule, the dislocation the exception. The humeral condyles present an almost insuperable obstacle to the passing backward and upward of the coronoid process which, consequently, in most cases, breaks off the condyles and carries the condylar fragment upward and backward with it, just as the upper row of carpal bones break off and carry upward and backward with them

the lower end of the obstructing radius. The anterior portion of the radial head strikes against the capitellum, aiding in the fracture of the condyle or being broken off itself. Not only does the coronoid process offer the chief obstruction to the humerus and play the most important part in producing the more or less transverse fracture of the humerus but is probably also responsible for the not infrequent vertical splitting of the condyles into a T-fracture. When the vertical line of fracture can be seen clearly by the X-ray it is usually seen to be almost always about opposite the tip of the coronoid process. (See Figs. 4A and 5A.) The prominent ridge on the articular surface of the olecranon begins anteriorly at the tip of the coronoid, passing backward through about the middle of the articular surface to the tip of the olecranon, and fits into the correspondingly-marked depression on the articular surface of the lower end of the humerus. This ridge therefore has the effect of a wedge tending to split the condyles into two lateral fragments through the weakest portion of the condyles. Since it extends through the whole joint from the tip of the coronoid to that of the olecranon, its wedge effect is probably exerted at the moment of impact and when the elbow strikes the ground from the secondary flexion of the elbow. Lateral displacement of the lower fragment seems to be frequently associated with the T-fracture, indicating that it has something to do with its mechanism. (See Figs. 4A and 5A.)

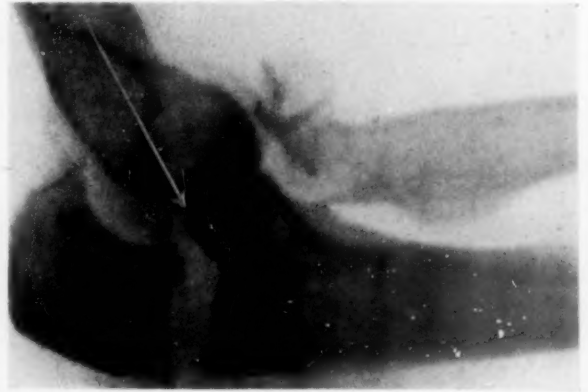


FIG. 7.—Typical fracture of the olecranon. Most recent fractures and dislocations of the elbow are fixed in flexion though gravity tends to increase extension later, even with the patient supporting the weight of the forearm. When the elbow struck the ground due to the secondary flexion following the first impact of the palm on the ground, the humerus was driven downward against the olecranon at the site of the fracture in it, suggesting this as the mechanism of the fracture.

The only remaining common fracture involving the elbow-joint is the transverse fracture of the olecranon. The writer is not familiar with any recognized explanation of the mechanism of this fracture. In Figure 7 we have an X-ray illustration of a transverse fracture of the olecranon associated with a typical fracture of the head of the radius. The latter fracture has long been recognized as being due to the fall on the hand. But both occurred together and therefore were due to the same force, that of the fall on the hand. A good case can be made out experimentally for the occurrence of the radial-head fracture at the moment of impact of the palm on the ground with the elbow in extension. When the elbow gives way in flexion, secondarily to the impact on the palm, the elbow must immediately afterward strike the ground on the posterior surface of the olecranon. The X-ray shows that



## ELBOW FRACTURES AND DISLOCATIONS

the olecranon fractures usually in its narrowest and weakest portion and just under the most prominent portion of the articular surface of the humerus in contact with it, *i.e.*, just where the humerus would act most effectively as a blunt wedge driven downward into the olecranon. If some prominent object like a stone should happen to lie on the ground just under the olecranon it might be fractured more easily. Indeed, striking on such a prominent object might be necessary for the fracture.

About the only remaining lesion that occurs often enough to deserve attention here is the dislocation of the head of the radius, which may be



FIG. 8.—This typical anterior dislocation of the head of the radius was never seen by the writer. The degree of extension of the elbow suggests that it is probably an old and not a recent dislocation. The secondary flexion and striking of the elbow on the ground suggested as the cause of the fracture of the olecranon in Fig. 7, might account for this dislocation if some object like a stone so lay on the ground that only the head of the radius struck on it.

anterior, external or posterior, the anterior being much the most frequent. (See Fig. 8.) It is much less frequent than fracture of the olecranon, which can scarcely be called common. The greatest violence from the fall on the hand is felt at the elbow at the moment of impact of the palm on the ground. By the time the elbow strikes the ground much of this violence has been spent, which may have something to do with the infrequency of fracture of the olecranon and dislocation of the head of the radius. This dislocation may occur alone or in conjunction with a fracture of the ulna immediately below the elbow-joint, the fracture being angulated anteriorly and the radius dislocated anteriorly. If the elbow struck on an underlying stone or other such object and this were of such a size and shape and were so situated that only the radial head received the impact on it, one can easily imagine the force driving the radial head into an anterior dislocation. The small chances of the elbow receiving so restricted a blow might explain the infrequency of this dislocation. Again, if such an object happened to so lie that the impact on it were received by the radius and ulna a little lower in the

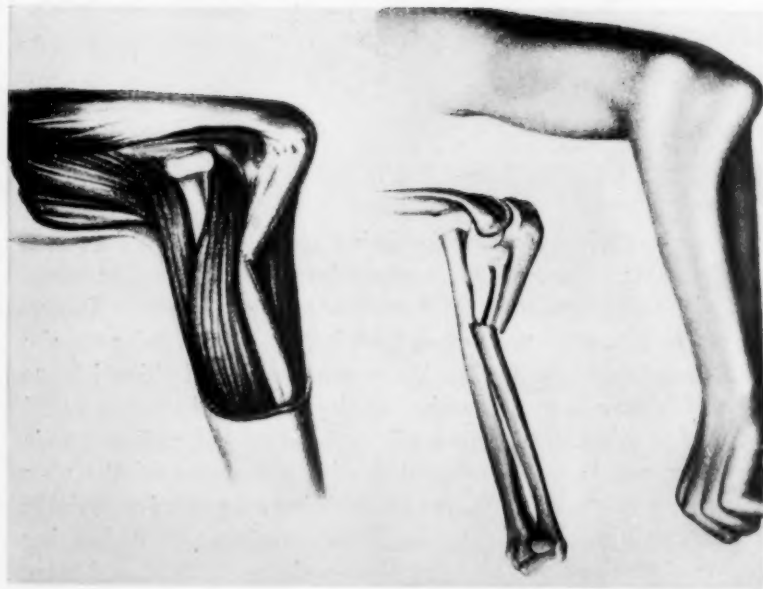


FIG. 9.—(Helferich-Bloodgood.) This case of Helferich, now well recognized as typical, is much quoted. If a suitable shaped object like a stone so lay on the ground when the elbow struck it that the site of fracture in the ulna came in contact with the stone, this mechanism could readily account for the fracture and the dislocation of the radius. The writer had a very similar case with milder deformity, the X-ray plates of which have been



FIG. 10.—The mechanism in this case is probably very similar to that suggested for Helferich's case shown in Fig. 9, although the anterior dislocation of the head of the radius seems to be absent. Open reduction and nailing of the ulnar fracture was done, during which the radial head was found completely detached from its shaft and broken up into three pieces of about equal size, which were removed.

## ELBOW FRACTURES AND DISLOCATIONS

forearm, it might readily produce a fracture of the shaft of the ulna with anterior angulation at the seat of fracture and an anterior dislocation of the radial head. (See Fig. 9.) This would be the equivalent of a high fracture of both bones of the forearm, the ulna breaking at the point of impact from direct violence, the radius giving way at its joint connections from indirect violence. The relations of the articular surfaces of the ulna and humerus would make an anterior dislocation of the ulna impossible, while those of the radius to the humerus would make an anterior dislocation of the radial head easily possible.

### CONCLUSIONS

(1) Most fractures and dislocations in the elbow region are produced by the fall on the hand.

(2) The force of the fall on the hand tends to flex, not extend, the elbow-joint.

(3) At the moment of impact of the palm on the ground the line of force coming downward through the humerus meets the line of resistance coming upward from the ground, chiefly through the radius, at the elbow-joint, both passing out of the limb posteriorly at an angle to each other. When the effect of the meeting of these forces is to break the skeleton in or near the joint, the remaining momentum drives the two fragments in the lines of these forces.

(4) The resistance of the ground at the moment of impact tends to drive the radius and ulna upward and backward behind the humerus, this tendency being increased by the flexion of the elbow which immediately follows the impact. This mechanism accounts for the typical deformity in the most frequent fracture here, the supracondylar, and in the most frequent dislocation, the posterior, of the elbow-joint.

(5) The typical fracture of the head of the radius is produced by the impact of the palm on the ground. The typical fracture of the olecranon and the anterior dislocation of the head of the radius are produced by the force of the elbow striking the ground from the secondary flexion caused by the impact of the palm on the ground.

(6) Immediately after a fracture or a dislocation occurs in this region, the pain and irritation cause contraction of the muscles and fixation of the elbow in the position it occupied when the fracture or dislocation took place, *i.e.*, in flexion. This is indicated by the fact that the elbow is practically always found in flexion in these injuries and that the patient supports the weight of the forearm to prevent change of this position by gravity.

# TRANSACTIONS

OF THE

## PHILADELPHIA ACADEMY OF SURGERY

STATED MEETING HELD OCTOBER 1, 1928.

The President, DR. ASTLEY P. C. ASHHURST, in the Chair

DR. CALVIN M. SMYTH, JR., Recorder

DR. GEORGE W. WAGONER remarked that the differential diagnosis of destructive processes of the vertebral column is frequently difficult. He desired to report a case in which destruction of the body of the first lumbar vertebra by an invading retro-peritoneal sarcoma was, for a time, mistaken for tuberculosis of that vertebra.

A girl nine years of age was admitted August 13, 1927, in the Carnett Surgical Service at the Graduate Hospital, suffering with acute pain in the lower right abdomen. The onset of pain had been sudden and not preceded by a period of disability. An X-ray study for possible renal calculus revealed a destructive process of the body of the first lumbar vertebra, and the patient was transferred to the Orthopædic Service of Dr. DeForest P. Willard with the diagnosis of tuberculosis of the lumbar spine.

Examination elicited limitation of and pain on motion of the lumbar spine, spasm of the erector spinæ muscles, and a small kyphos over the first lumbar vertebra. Parietal tenderness and pain was present in the skin areas supplied by the eleventh and twelfth right thoracic intercostal nerves.

Extension on a Bradford frame immediately relieved the abdominal pain. The patient was then encased in a plaster jacket and, at the request of her parents, discharged on August 24 to the care of her family physician. Six days later the patient was readmitted, complaining of severe pain in both hips. Extension applied to both lower extremities gave but partial relief from pain. Examination failed to demonstrate any abnormality in either hip-joint. Symptoms of cord compression developed evidenced by a diffuse sensory involvement and a progressive flaccid motor paralysis. On September 13 the plaster jacket was removed and a small protruding mass was found presenting between the eleventh and twelfth ribs on the right, two centimetres lateral to their vertebral articulations. An attempt was made to decompress the cord by aspiration of this mass. Despite the use of a large trocar and canula and an aspirating pump, no material was removed excepting several caseous plugs. The sensory and motor paralysis progressed until it became complete below the level of the twelfth thoracic cord segment. After neurological consultation it was decided to perform a laminectomy and decompress the cord; the diagnosis was Pott's paraplegia with extra-dural compression of the spinal cord.

On September 17 the spinous processes of the tenth, eleventh, and twelfth thoracic and the first lumbar vertebrae were removed. The dura mater was found to be overlain with dense masses of granulation tissue and the subarachnoid space obliterated. Removal of the granulation tissue released the dural constrictions and permitted the subarachnoid space to distend with cerebro-

## RETRO-PERITONEAL SARCOMA

spinal fluid. A slight amount of caseous pus was present in the anterior portion of the wound. Subsequent culture of this material was sterile and guinea pig inoculation was negative for tuberculosis. It was noted as an usual feature at the time of operation that several of the vertebral laminae were necrotic. No gross tumor tissue was seen. The patient recovered consciousness on the table and was able to move her toes voluntarily and perceive stimuli applied to her lower extremities.

Following decompression the sensory and motor paralysis rapidly vanished only to reappear three weeks later. A rapidly growing, semifluctuating mass appeared at the site of operation. As this mass increased in size the paralysis increased in degree, until four weeks after the initial operation the patient had a complete paraplegia. A biopsy of the tumor was performed on November 15. At this time the mass measured seven centimetres in diameter. Microscopic examination of the tissue removed showed a round-cell sarcoma of retro-peritoneal origin.

Marked improvement in the general condition of the patient, complete obliteration of the protruding mass and a slight lessening of the paralysis followed extensive X-ray and deep therapy treatment by Dr. G. E. Pfahler. The relief following radiation, however, was temporary; pulmonary metastasis occurred and was followed by massive pleural effusions with cardiac embarrassment, generalized oedema and extreme emaciation. On May 5, 1928, the patient died.

Doctor Wagoner commented on this history as follows:—Failure by röntgenologist, surgeon and orthopaedist to interpret properly the original lateral röntgenograph of the lumbar spine led to an erroneous diagnosis which was not corrected until three months after the first admission. In this röntgenograph the body of the first lumbar vertebra was shown to be partially destroyed. The remaining fragment was wedge-shaped and strongly suggested the presence of a destructive tuberculous process. But the articular cartilages were not involved as would have been the case had tuberculosis been present. Destruction of the body of a vertebra without destruction of the articular cartilages is characteristic of a sarcomatous invasion.

In addition to the misinterpretation of the röntgenograph, several features in the course of the illness of this patient stand out in retrospect as being opposed to the original diagnosis of tuberculosis of the first lumbar vertebra. (1) Inability to aspirate the small mass protruding between the eleventh and twelfth ribs posteriorly. (2) The rapid and complete flaccid paralysis. (3) The absence of a large collection of pus upon removal of the spinous processes. (4) The necrosis of the vertebral laminae noted at time of the laminectomy.

DOCTOR WAGONER reported also the summary of a history extending over some thirteen years.

A negro boy, born in Philadelphia in 1908. In 1915 developed a swelling on the dorsum of the left hand at the base of the fifth phalanx which opened and became a draining wound. Three years later (1918), a second swelling appeared on the dorsum of the left hand near the wrist and also opened spontaneously. These lesions were untreated until October 19, 1920, when the patient was admitted to the dermatological clinic of Doctor Schamberg at



## PHILADELPHIA ACADEMY OF SURGERY

the Graduate Hospital. A diagnosis of tuberculosis of the skin was made and X-ray therapy instituted. After November 16, 1920, the patient failed to report for further treatment. On October 9, 1923, the patient returned to the dermatological clinic with the lesions on the dorsum of the left hand much increased in extent. Further X-ray therapy was given at regular intervals until June 18, 1925, when all the lesions were healed and the skin presented a healthy appearance.

On July 2, 1926, after an absence of a year, the patient returned, complaining of pain in the left wrist which he had first noticed several days previously. A röntgenograph of the wrist on that date showed a marked loss of bone salts with some periosteal reaction in the distal end of the left ulna, together with some opacity in the left semilunar. Actual bone destruction, however, was not demonstrable. A röntgenograph of the chest was negative for tuberculosis. The diagnosis of early tuberculosis of the left ulna and semilunar was made and the former treatment by radiation was reinstituted. Four weeks later a röntgenograph showed complete destruction of the distal diaphyseal end of the left ulna with invasion of the left trapezium. The patient was transferred to the surgical service of Dr. J. B. Carnett and on August 16, 1926, the bones of the left forearm were scraped.

The patient was transferred August 20 to the orthopaedic service of Dr. DeForest P. Willard, with the diagnosis of tuberculous osteomyelitis of the left ulna. Treatment by Alpine lamp, X-ray, and immobilization was continued without arresting the rapid extension of the destructive process. A large, tense, fluctuating mass developed on the ulnar aspect of the left forearm adjacent to the wrist. This mass increased in size until on January 24, 1927, the forearm was incised and the contents of the mass evacuated and the fragments of the ulna curetted. At the time of operation the orthopaedists present differed as to whether the material evacuated was tuberculous or sarcomatous. Culture of the material removed was sterile, guinea-pig inoculation was negative for tuberculosis, but a microscopic examination of the material was reported as tuberculous tissue by a pathologist not regularly on service at the hospital. The attending pathologist upon his return diagnosed the material as being typical of sarcoma.

Bone destruction continued and a new mass of necrotic tissue was formed which was evacuated on March 1, 1927. At this second operation the material was diagnosed clinically as sarcomatous. The pathologist's report of tissue removed at this operation was that of osteogenic sarcoma. On March 15, 1927, the left arm was amputated in the upper third of the humerus.

Further extension of the process with invasion of the stump of the left humerus necessitated amputation at the shoulder joint. Pulmonary metastasis, however, had occurred and these were followed by metastasis to the spine. The invasion of the spine in the lumbar and lower thoracic vertebrae resulted in complete paralysis of the lower extremities and trunk below the level of the twelfth thoracic cord segment. On February 2, 1928, the patient died.

DR. DEFOREST P. WILLARD said that in the first case of sarcoma of the retro-peritoneal glands, which was thought to be tuberculosis of the spine, no suspicion of the true condition was had until the boggy mass appeared over the spine several months after laminectomy. Doctor Pfahler showed that the orthopaedic service had been wrong in the interpretation of the film, and pointed out that destruction of the vertebral body without destruction of

#### INTESTINAL OBSTRUCTION COMPLICATING FRACTURED PELVIS

the cartilaginous discs on either side of the body generally means sarcoma. If the process is tuberculous the destruction of the discs usually occurs before the bone is involved.

The second case of sarcoma of the ulna presented two very interesting problems, one, whether the boy had tuberculosis of the ulna; and second, whether the treatment for the tuberculous skin condition which he had several years before and the irritation from this treatment had anything to do with irritating the sarcomatous process. The clinical diagnosis of sarcoma was made before the laboratory reported it. The pathologist reported the mass in the arm as tuberculous, and it was not until the second operation, when it was reported as clinically sarcoma, that reëxamination of the first mass resulted in the diagnosis of sarcoma from the first and second sections. This proves that reliance on a cursory laboratory examination is unsafe. Frozen sections, in the speaker's judgment, are of no use and he believes only long serial sections have any value.

#### INTESTINAL OBSTRUCTION COMPLICATING FRACTURED PELVIS

DR. ELDRIDGE L. ELIASON presented a man aged forty-four, who was admitted to Service C of the University of Pennsylvania Hospital suffering from the effects of a collision between a locomotive and the car he was driving, as a result of which he was thrown thirty or forty feet. The patient was in state of shock. The right femur was in the position characteristic of posterior dislocation at the hip. The abdomen was flat and rigid. Peristalsis was diminished, otherwise normal in its characteristics. The blood pressure was 75/50; pulse 92.

*Diagnosis.*—(1) Posterior dislocation of right femur at the hip-joint. (2) Abdominal trauma, possibly ruptured liver. (3) Mild concussion. An X-ray revealed the dislocation as well as a fracture of rami of the ischium and pubes.

Four days later the patient complained of abdominal pain. Physical examination revealed a distended abdomen and a mass in the lower right quadrant which was taken to be a retro-peritoneal hematoma resulting from the fracture of the pelvis. Some elevation of temperature persisted with some abdominal distortion, associated with increased peristalsis and difficulty in moving the bowels for a period of two weeks. At the end of six weeks the patient was discharged. Three months later at a follow-up examination he was suspected of having an intestinal obstruction and, after an X-ray study confirmed this, he was re-admitted and operation undertaken. The abdomen was opened through a low right paramedian incision and a portion of greatly distended small gut presented itself into the wound. The bowel was markedly hypertrophied, and was traced to a mass of adhesions of the small bowel in the right lower quadrant, which apparently was adherent to the lateral wall. After great difficulty the mass was freed from the adhesions. There was a rent in the mesentery of the terminal ileum through which a more proximal loop of ileum had prolapsed and, after undergoing partial volvulation, had become adherent to the lateral wall of the pelvis at the site of former fracture of the pelvis. When the adhesions were freed and the gut was entirely exposed the viscus was in such condition that a resection was deemed the best procedure. The portion between the distended ileum and the cæcum was

## PHILADELPHIA ACADEMY OF SURGERY

resected, turning in the terminal ileum just before it entered the cæcum to form a blind stump. The ileum was then anastomosed to the cæcum by an end-to-side anastomosis.

The patient made a fairly smooth recovery and was discharged cured.

Doctor Eliason remarked that the interesting feature about this case was the error in diagnosis in the beginning. He knew the patient had a mass, he knew he had a peritoneal irritation and some distention, but he was never extremely ill. The mass subsided and so decreased in size that at the time of discharge it was practically negligible. When he reported for the follow-up examination, he complained simply of indigestion, had no pain, but was losing weight and had to be extremely careful of his diet. It was difficult to convince him at this time of the necessity for X-ray study.

### PUNCTURED WOUND OF PLEURA AND PRECORDIUM

DOCTOR ELIASON presented a youth eighteen years of age who was admitted to Service C at the University of Pennsylvania Hospital, suffering from the results of an explosion of a glass jar. The physical examination revealed the following:

1. Severe laceration and contusion of right hand, thumb all but amputated, small finger torn through all except bone, most of structure of ring finger blown away, extensive burn of right forearm. 2. Puncture wounds by glass all over the front of the right arm, chest, abdomen, thighs, face and right ear. The most important of which were: (a) Penetrating wound of chest wall just lateral to the precordium (on the left). (b) Perforating wound of right external ear. (c) Perforating wound of the left orbit, without evident involvement of the eye ball. (No wounds perforated the peritoneal cavity.) (d) Deep wound in region of the right shoulder. 3. Burns of eyes, lids, scleral conjunctivae.

The operative procedures included debridement of wounds, ligation of blood vessels, amputation of right thumb and right fourth finger, removal of foreign bodies from soft tissues and left pleural cavity.

The wound over the sternum was found to contain many particles of glass. These were removed with the infected tissue. There was exposed a probable fracture of the sternum. Closure with interrupted silk after insertion of one piece of rubber dam. Many other wounds of the chest were found, pieces of glass removed from them and the wounds thoroughly disinfected with mercurochrome. One wound in the chest wall, at about the fifth interspace, was found to penetrate below the muscles and opened into the left pleural cavity. Pulsation of the heart could be distinctly palpated and on insertion of the finger a piece of glass was found. It was removed after inserting the cholecystoscope. The lung was then distended by positive pressure and suction and the wound closed with three interrupted sutures of catgut. On attempting to remove the suction tip, resistance was encountered and in attempting to disengage its tip by traction, the apex of the heart was pulled up into the wound, due to the fact that the suction tip had entered a wound in the pericardium which had not been previously discovered. The apex was disengaged and the heart allowed to drop back into place. During these manipulations the pulse rate reached 120, but promptly dropped to 80 as soon as the sucking wound in the chest wall was closed.

## FRACTURES AND DISLOCATIONS OF THE ELBOW

The patient made a very good recovery and convalesced smoothly. An X-ray examination of the chest four days later showed no evidence of a pneumothorax, but definite evidence of a pneumo-pericardium.

## FRACTURES AND DISLOCATIONS OF THE ELBOW

DR. T. TURNER THOMAS read a paper entitled "A Contribution to the Mechanism of Fractures and Dislocations in the Elbow Region," for which see page 108.

DR. HENRY P. BROWN said that Doctor Thomas stated in order to produce the same degree of fracture as caused by the fall, he had to hammer the bone a great many times. It seemed to the speaker that any one of these hard blows with the hammer would have been as severe as the impact produced by a fall. If the impact of the one fall caused the fracture, it should have been possible to have produced the same thing with one blow of the hammer.

DR. T. TURNER THOMAS in replying to Doctor Brown's question said that he did not think the force of one blow from an ordinary wooden mallet would be as great as that from the impact of a body falling on the ground.

He had rather expected somebody to raise the question as to whether the impact of the palm on the ground would not produce hyperextension of the elbow joint in a child because the elbow of the child is so much more relaxed than that of the adult. The speaker did some experimental work recently on the cadaver of the child but could obtain only bodies of the new-born and the skeletons were so delicate that he could not apply force satisfactorily. Of course the results obtained from experimental work on the bodies of the new-born are not of much value, because the child does not fall until after he begins to walk and for a long time afterward not with enough force to produce typical results. But such results as were obtained in the cadaver arms of the new-born seemed to confirm those obtained in the adult cadavers in showing that the force of the fall on the hand would produce flexion and not extension of the elbow-joint in them.

# TRANSACTIONS

OF THE

## NEW YORK SURGICAL SOCIETY

STATED MEETING HELD OCTOBER 10, 1928

The President, DR. FRANK S. MATHEWS, in the Chair

### ACUTE APPENDICITIS WITH PERITONITIS IN A YOUNG CHILD

DR. PAUL DINEEN presented a boy of twelve, who was admitted to the New York Hospital March 4, 1928. At 5:00 A. M. on the day prior to admission he was taken with sharp cramp-like abdominal pain, generalized at first over the whole abdomen and then localizing in the right lower quadrant. On admission temperature was 101.8; white blood cells 21,000 and polymorphonuclears 90 per cent. Urine negative. Past history was negative save for tonsillectomy seven years before. Abdomen showed marked tenderness and rigidity in right lower quadrant, most severe over McBurney's point. No palpable masses.

*Operation.*—McBurney incision. Peritoneum very cedematous; peritoneal cavity contained a large quantity of thick, foul, reddish-yellow fluid. The appendix was bound down by friable adhesions. Much colon smelling pus escaped from the appendix region. The appendix was large, red-black in color throughout, and so distended that it looked like a loop of small intestine with a perforation near the tip. Appendix was removed, stump not inverted as the cæcum was very friable. Wound left open. No sutures. Two cigarette drains. Culture of fluid showed coli communis.

*Post-Operative Course.*—Temperature fell immediately after operation but on third day it began to mount and ten days after initial operation patient was returned to operating room for drainage of pelvic abscess. During rectal examination there was an escape of a large amount of pus from the McBurney incision. Patient quickly responded favorably and was able to leave the hospital fifteen days after the first operation with a small granulating wound. One month after discharge a slight bulge was noted in the centre of the McBurney incision and there was a wide fascial separation.

June 13, 1928, three months after original operation, the boy was readmitted and the incisional hernia repaired, a small sac being found in centre of wound with adherent omentum. The peritoneal cavity showed very few adhesions. Anatomical repair. Discharged with firmly healed wound twelve days after admission.

This boy is shown in connection with the paper of the evening. An acute phlegmonous infection with a very short history. It emphasizes the severity of infections in young subjects. It brings up the question of drainage and the results. On the Second Surgical Division, Doctor Pool advocates drainage of these McBurney wounds with two cigarette drains and no sutures for any layer. Post-operative herniæ have been less since the adoption of this procedure.

Dr. John Garlock has been studying the cases of acute appendicitis in



## TORSION OF MESENTERY

Doctor Pool's Division since Doctor Bancroft in 1920 reported 295 drained cases with 15 per cent. post-operative herniæ. Doctor Garlock reports the cases from January, 1921, to July, 1927. They are classified into four groups. *All drained cases.*

A. McBurney incision—No sutures—followed 264; Hernia 17 = 6.4 per cent.

B. McBurney incision—Sutured—followed 104; Hernia 16 = 11.5 per cent.

C. Right Rectus incision—Sutured—followed 50; Hernia 8 = 16 per cent.

*Not drained.* D. McBurney incision—Sutured—followed 216; Hernia 0

## TORSION OF MESENTERY

DR. PAUL DINEEN presented a man, forty-two years of age, who entered the New York Hospital June 28, 1928, with a history of acute abdominal pain of twenty-four hours' duration. While eating and apparently well he was suddenly taken with acute abdominal pain, first located in the right lower quadrant and then radiating to upper abdomen. The pain was cramp-like in character, quite severe and lasted six hours, the patient vomiting during the attack. The pain disappeared for several hours and then recurred with such vigor that the patient came to the hospital. Bowels regular though they had not moved for twenty-four hours. Past history negative.

*Physical Examination.*—Abdomen moderately distended. Marked tenderness in right lower quadrant with considerable muscle rigidity of entire right rectus muscle. No tenderness elsewhere. No masses. No visible peristalsis. Rectal negative. Temperature 101.2. White blood cells 14,300; morphonuclears 84 per cent.

*Operation.*—Through a McBurney incision peritoneum was opened and a quantity of blood-stained fluid appeared. A right rectus incision was then done and on opening the peritoneum more of the blood-stained fluid was seen. A loop of constricted small intestine presented in the wound. This was found to be about two feet in length. At either end of the constricted portion the bowel was normal in appearance. The bowel in the constricted portion was dark-bluish in color but there was no evidence of gangrene. Mesentery of the collapsed loop of small intestine was twisted upon itself by a half turn. The mesentery was very friable, thick, cedematous and markedly swollen and in several places there were dark blue areas about 2 cm. in diameter. The mesentery was so friable that it was torn in several places and there was much venous oozing. Pancreas did not feel enlarged. No fat necrosis.

The appendix was found high in the upper quadrant beneath the liver and showed no sign of inflammation. After straightening out the mesentery the small intestine lost its contracted state and became normal in contour. Both incisions were closed without drainage.

*Course.*—Patient made an uneventful recovery and left the hospital in thirteen days. Barium enema shows no irregularities of the large bowel.

An unusual case of intestinal obstruction falling under the category of the volvulus type. Volvulus of the sigmoid and cæcum are not unfrequent but torsion of the mesentery of the small bowel is not so common.

In the *British Medical Journal* for June, 1927, Palit reports a case of torsion of the mesentery and states that in his review of the literature, he had found no reported cases. His case was more severe—five days obstructed,

## NEW YORK SURGICAL SOCIETY

showed a fixation of the ileum in the right lower quadrant and a twist right to left with gangrenous obstructed bowel. He was unable to relieve the bound down ileum. Patient died, but no autopsy. In the French literature he found a case reported by Pierre Delbet, "Occlusion intestinale par torsion de la totalité de l'intestin grele et de son mesenterie" in the *Bulletin et Memoires de la Société de Chirurgie*, 1920. Delbet's case got well. He also found the ileum fixed in the right lower quadrant and the twist right to left. Delbet ascribed the condition to adhesions and bands, probably congenital folds.

### IRRADIATION AND CONSERVATIVE SURGERY IN PRIMARY INOPERABLE CARCINOMA OF THE BREAST

DOCTOR BURTON J. LEE presented a woman who, at the time of her admission, nine years and three months ago, to the Memorial Hospital in July, 1919, was sixty-five years of age.

She stated then that seven months prior to her admission a small tumor had appeared in the upper outer quadrant of the right breast. The breast slowly became larger and heavier than the left and two months prior to her admission she first noticed pain. At the same time a second soft nodule appeared in the lower outer quadrant of the breast. She had had four children and had nursed all, eighteen months each, without any complications. She had never had any serious illness.

Examination revealed a poorly nourished, anæmic woman and was without interest except for the local condition. The right breast was diffusely involved in a tumor process measuring 9 cm. in diameter. The skin was reddened and cedematous and was infiltrated with tumor tissue. The breast was movable over the chest wall. In the right axilla three enlarged firm nodes could be palpated and one in the right supraclavicular region. A chest plate made at this time was negative for evidence of pulmonary metastases.

Between July, 1919, and January, 1920, she received eighteen X-ray treatments of the low voltage type. Each treatment lasted four minutes with the following factors: 135 K.V., 7 m.amp. of current, 8½-inch spark gap, 4 mm. of aluminum filtration and an 8-inch focal skin distance.

In January, 1920, local mastectomy was decided upon because of beginning ulceration of the skin overlying the breast. January 15, 1920, under general anæsthesia this operation was performed, removing the breast alone, without any attempt at axillary dissection. A small area could not be completely closed and skin grafting was subsequently carried out.

DR. JAMES EWING reported the tumor as a compact cellular carcinoma, made up of broad groups of clear cells.

In March, 1920, the mass in the axilla measured 5 cm. in diameter and low voltage X-ray treatment was again employed over this area. In January, 1921, under novocaine anæsthesia, the axillary tumor was excised but some small shotty nodes, palpable under the pectoral muscle were not removed. Four bare tubes of radium emanation, furnishing a dosage of 200 millicurie hours were buried in this area. The pathological report on the nodes removed was carcinoma simplex. There was some delay in healing, the wound not closing completely until two months after operation.

Some thickening has persisted in the axilla which is apparently scar tissue. Since June, 1922, there has been no evidence of disease.

This patient was shown as a case successfully treated by irradiation and

## SURGERY IN CARCINOMA OF THE BREAST

conservative surgery nine years and three months since the beginning of treatment, and eight years and nine months since the mastectomy was performed.

DR. BURTON J. LEE presented a woman, who at the time of her admission to the Memorial Hospital in August, 1920, was fifty-three years of age. Her family history and past history were negative. Lactation had never been present.

In July, 1920, she noticed a small, painless lump in the upper inner quadrant of the right breast. Growth was rapid and for two weeks prior to her admission she had experienced considerable pain. Examination revealed a mass of firm consistency, 10 cm. in diameter in the lower inner quadrant of the right breast. Nipple retraction and fixation were present. The skin was smooth and glossy with definite adherence to the underlying tumor, but the breast moved easily over the chest wall. There were several large nodes in the right axilla, one large node in the left axilla, and questionable supraclavicular fulness in the right side. The chest plate was negative.

In August, 1920, the patient received a low voltage X-ray cycle of five treatments over the right breast and lymph drainage areas. The time of each treatment was six minutes and the following factors were employed: 135 K.V., 6 m.amp. of current, 8 $\frac{3}{4}$ -inch spark gap, 3 mm. of aluminum filtration and a 10-inch focal skin distance. This cycle was repeated in September, 1920. There was a very marked effect following these treatments, the tumor becoming appreciably smaller but the axillary nodes remained unchanged. The skin showed marked irradiation changes.

In January, 1921, under novocaine anaesthesia an axillary dissection was done without removing the pectoral muscles, and many discreet shotty nodes were excised. Bare tubes were inserted in the operative field, giving a dosage of 1300 millicurie hours. The healing of the incision was somewhat delayed.

Dr. James Ewing reported upon the material removed at the operation. His report was: "Fibrosed lymph nodes. No tumor."

The right breast became quite painful and ulceration of the skin appeared. For this reason local mastectomy was decided upon and it was deemed wise at the same time to clear out the axilla again. To facilitate the procedure a portion of the large pectoral muscle was removed. Complete closure of the wound was not attempted and three weeks later skin grafting was done.

Doctor Ewing reported on the tissue removed at the second operation as follows: "The tumor is a cellular plexiform carcinoma."

There has been no further treatment since that time. There has been no local recurrence and while a small node is present in the left axilla, it has remained unchanged for several years.

The patient was shown as a case successfully treated by irradiation and conservative surgical methods eight years and two months since admission to the hospital, and seven years and seven months since operation.

DR. SEWARD ERDMAN called attention to the statement of Doctor Lee that in the first case he definitely felt a supraclavicular nodes and in the second there was questionable supraclavicular fulness. This being so, if nothing was done at the time of the axillary dissection in the way of surgical removal of the involved supraclavicular nodes how did X-ray treatment prevent metastasis? Why do cases with enlarged supraclavicular nodes practically always metastasize after breast removal? The speaker had always thought it was because at the time of operation the cancer had already gone further than the obvious involvement of the operative field. In a case treated

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by radio therapy, is it claimed that this affects the distant parts of the body or only the area treated? In other words, in these women who went free from metastasis for eight and nine years after merely local or deep local radiation it would seem the cancers were operable; because the long period of cure demonstrates that from the start the cancer process was and has remained localized.

DR. ROBERT T. MORRIS asked Doctor Lee if he had any idea what proportion of cases of carcinoma of the breast will make a favorable response to radiation therapy and if there is any way of anticipating the ones that will make such response except by way of trial and error.

DR. ALEXIS V. MOSCHCOWITZ said that he has always been and is still skeptical about the actual value of irradiation before any operation for carcinoma of the breast; nor, for that matter, is he convinced of the value of irradiation after the operation. The two cases presented by Doctor Lee, however, deserve pains-taking consideration. Doctor Moschcowitz has not thus far obtained such outstanding results. He has found that after an amputation of the breast for carcinoma, when there are local recurrences or distant metastases, no amount of irradiation has been able to show one definite cure. He has gone into this subject thoroughly in collaboration with Doctor Colp and Doctor Klingenstein and has found that when cases of this nature did not die from some intercurrent disease they eventually all died from carcinoma.

Doctor Moschcowitz propounded the question whether the cases presented by Doctor Lee were cured by the operation which, in spite of the inoperability, was undertaken; or by the irradiation; or by a combination of both therapies. As a matter of argument, any one of the three may have been the possible cause.

DR. FRANK S. MATHEWS said that Doctor Lee probably classified these two cases as inoperable in the sense of not expecting a cure from operation, yet both cases were operated on after vigorous X-ray treatment and when the skin had begun to break down. He asked Doctor Lee why he decided to proceed as he had instead of first doing the operation and then instituting active radio-therapy.

DOCTOR LEE, in closing the discussion, replied to Doctor Erdman's question, asking for an explanation of the response (in these patients) of the supraclavicular nodes to irradiation, that the reason could be found in the fact that the tumor tissue was radio-sensitive. There is a wide variation in radio-sensitivity in mammary cancers, some being highly sensitive while others show little response to the use of these physical agents. In the patient in whom radium emanation seeds were implanted in the axillary nodes the satisfactory end result was due in considerable measure to the destruction of the tumor tissue in these nodes by the radium used.

There is always a possibility of error in making a clinical diagnosis of axillary node involvement. Out of one hundred cases in which the surgeon

#### CHONDROMA OF CHEST WALL-RESECTION

believes there is node involvement, he will find after radical amputation, that the nodes are free in sixteen or seventeen patients. Conversely, in one hundred cases who are diagnosed as free from node involvement, examination of the axillary contents after radical surgery, one will find the disease present in these nodes in sixteen or seventeen cases.

Of the two patients presented, in the first, histologic examination proved the presence of carcinoma in the nodes. In the second, after having received a prolonged course of irradiation, only fibrosis could be made out (in the nodes), making it impossible to prove metastasis to the nodes at the time of the patient's admission to the hospital.

These two proven cases of carcinoma of the breast have been presented to show end results from the combination of radio-therapy and palliative surgery. There is good reason to believe that the heavy irradiation applied to the breast and drainage areas, some time before surgery, has been an important factor in attaining the good results.

In answer to Doctor Morris' question concerning the proportion of cases of mammary cancer that will respond to irradiation, Doctor Lee replied that he could not give the exact percentage but that a great many are radio-sensitive. Not infrequently, following adequate irradiation of a tumor 2 or 3 cm. in diameter, a marked diminution in the size of the tumor is evident and in some instances a complete disappearance of the tumor mass had occurred. The more cellular and the more malignant the growth, the more radio-sensitive it is as a rule.

Concerning Doctor Moschcowitz's remarks, Doctor Lee was aware that Doctor Moschcowitz had always been skeptical about the value of irradiation. He wondered if Doctor Moschcowitz had followed cases treated by irradiation methods over a period of years, with a continuous follow-up month by month. Only by such a method could one expect to reach reasonable conclusions as to the efficacy of irradiation.

Doctor Lee stated that he felt that radical surgery with pre- and post-operative irradiation is the best method surgeons have at present to handle primary operable cases. In primary inoperable cases (those in which the surgeon cannot expect to completely remove the disease by radical surgery) the method of choice is irradiation combined with conservative surgery, as indications require it. Radical amputation followed by irradiation yields poorer results in the primary inoperable cases than the treatment applied in these two cases.

#### CHONDROMA OF CHEST WALL-RESECTION

DR. BURTON J. LEE presented an unmarried woman, thirty-eight years of age, who was first seen in February, 1924. In June, 1923, she accidentally discovered a swelling on the chest wall just above the right breast. There was never pain nor tenderness in or about this area. The breast history was negative and to the patient's recollection she had never received an injury which would account for the condition.



The findings on physical examination were negative except for the local condition. There was fulness over the middle portion of the right chest anteriorly, and  $7\frac{1}{2}$  cm. below the middle of the right clavicle there was a solid mass  $3\frac{1}{2}$  by  $2\frac{3}{4}$  cm. in size. There was no tenderness on pressure, and no redness nor adherence of the overlying skin. The mass seemed to be attached to the third rib and the adjacent costo-chondral junction. An X-ray plate made at this time failed to reveal a definite process in the chest wall but only an old healed tubercular lesion in the right apex.

The patient was kept under observation and one year later the mass had grown appreciably in size, measuring 6 by  $5\frac{1}{2}$  cm. in diameter. Two external applications of radium had been given by Doctor Robinson of the Post Graduate Hospital, who had referred the patient.

In May, 1927, further increase in size of the tumor was noted, and at this time stereoscopic films of the chest were made by Dr. Ralph Herendeen. His report was as follows: "There is a shadow in the middle portion of the right side of the chest which is irregular in outline and of calcareous density. The bulk of it lies anterior to the costo-sternal junction of the third and fourth ribs. Considerable calcareous density is seen in the third interspace behind the costal cartilage. No rib destruction is seen and the process apparently has no connection with the bony portion of the ribs. A chronic inflammatory process, tubercular infection, calcified hematoma, or osteo-chondro sarcoma is to be considered."

At this time a decision was made to expose the mass by a surgical incision and, if feasible, remove it. July 8, 1927, the patient was operated upon in the Memorial Hospital. Under general anaesthesia an incision 20 cm. long was made, running from the second costal cartilage on the right side beyond the sternum downward and inward, following the curve of the breast at the junction with the chest wall. The pectoral muscles were cut across and turned back and when the breast was reflected outward and downward, a firm, lobulated bulky tumor was exposed. The mass, 10 cm. in diameter, seemed to arise from the third costal cartilage and rib, and extended into the second and third interspaces, posteriorly. The anterior surface was removed with a chisel, exposing the remaining portion of the tumor which encroached upon the pleural cavity, but was still extrapleural. This was then removed with a curette and a portion of the third rib resected. During the procedure the internal mammary artery was exposed, but not injured, and an area of parietal pleura, 4 cm. in diameter, was also exposed but was not opened. The operative field was irrigated with saline and the pectoral muscles closed with catgut. The skin was closed with interrupted silk and one rubber tissue drain was placed down to the pleura.

The specimen was reported on by Dr. James Ewing. "The specimen consists of one large tumor mass 9 by 9 cm. in diameter. It is irregularly lobulated. The centre is osteoid and there are soft and hard chondromatous nodules throughout. It has the gross appearance of an osteo-chondroma."

Later, microscopic examination showed it to be a simple chondroma.

The patient made an uneventful recovery and has remained well and free from any recurrence up to the present time.

The patient was reported to demonstrate the ease with which excision may be accomplished without pleural damage.

#### INTESTINAL OBSTRUCTION AND MULTIPLE FÆCAL FISTULAS FOLLOWING OPERATION FOR APPENDICITIS

DR. EDWARD W. PETERSON presented a girl fourteen years of age, who in August, 1920, was operated upon at the Broad Street Hospital for acute

#### OVARIAN CYST WITH ACUTE APPENDICITIS

appendicitis. She had a stormy period following operation and on the eighteenth post-operative day she was again operated upon, the original incision reopened and a quantity of pus evacuated. Following this procedure faecal fistulas developed and the wound never healed. The patient was in Broad Street Hospital for three months, after which she was allowed to go home.

March 2, 1921, when six and one-half years old, she was admitted to the Post-Graduate Hospital. At the time of admission she was weak, emaciated, and acutely ill, and was running a temperature ranging from 100° in the morning to 104° in the evening. There was no natural bowel movement, all faeces escaping at the site of the appendix operation. The skin about the wound was badly eroded. The urine was loaded with pus and it was found that the temperature was due to a complicating acute pyelitis.

Under appropriate treatment the temperature came down, but at this stage the child weighed only twenty-five pounds and was a most unpromising surgical prospect. Something had to be done, however, so it was decided to attempt to close the faecal fistulas.

March 19, 1921, under ether anaesthesia, the abdomen was opened; the lower ileum found to be the seat of the obstruction. The gut was so thickened and knotted together that resection seemed to be the only rational procedure. The involved intestine, containing five fistulous openings, was resected and an end-to-end suture anastomosis was performed. Following operation the bowels moved with enema on the third day. There was a mild infection of the abdominal wound, but the patient made a good recovery and was sent to the Babies' Convalescent Home, at Sea Cliff, three weeks later, with instructions to return to the Post-Graduate Hospital in the fall for the repair of an incisional hernia, which developed after the operation.

October 1, 1921, the hernia was repaired, and the patient allowed to go home two weeks later. About a year after her discharge from the hospital she developed an acute cystitis and was taken to the New York Hospital, where an examination revealed the presence of two bladder stones, which were removed by a suprapubic operation. Since that time she has remained well and has developed into a healthy normal child of her years.

#### OVARIAN CYST WITH TWISTED PEDICLE SIMULATING ACUTE APPENDICITIS

DOCTOR PETERSON presented a girl, eight years of age, who was admitted to the Post-Graduate Hospital, January 21, 1928, as an emergency case of *acute traumatic appendicitis*. January 19 she had been kicked in the region of the right groin or hip by one of her playmates. That evening she complained of severe pain in the lower abdomen and vomited her supper. She continued to vomit all food and liquids, up to the time of her admission to the hospital. There was no bowel movement, and when enemata were given, not even flatus was passed. The temperature was normal for the first two days of the illness and only slightly elevated on the third day. Blood examination, at the time of admission, showed 13,200 leucocytes, with 80 per cent. of polymorphonuclear cells.

The physical examination was negative, except for moderate tenderness and resistance just above and to the right of the symphysis pubis. Rectal examination revealed a smooth, tense, globular mass in the mid-line and slightly to the right. Owing to the severe pain during the attack, with persistent vomiting and obstinate constipation, unaccompanied by fever, a diagnosis of ovarian cyst with twisted pedicle was made before operation.

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At operation a cyst of the right ovary was found, with two complete twists of its pedicle. The appendix showed enough pathology to warrant its removal. An uneventful recovery followed.

### AFFECTIONS OF THE APPENDIX IN YOUNG CHILDREN

DR. EDWARD W. PETERSON read a paper with the above title for which see page 48.

DR. ROBERT T. MORRIS asked if Doctor Peterson had examined the sympathetic lumbar ganglia for differential diagnosis; it seems that the patient had a teratoma and differential diagnosis, aside from palpation, might have been made by the fact that the second and third lumbar ganglia on both sides were hypersensitive, whereas in a chronic appendicitis with fibrosis there would have been a sensitiveness of the fused ganglion on the right side only. In an acute case, of course, there would be no sensitiveness of the lumbar sympathetic ganglia. As to the question of traumatic appendicitis, this condition does occur and it might have appeared in the case referred to by Doctor Peterson. Doctor Morris doubted if it was due to a direct blow upon the appendix, but the blow lifts the cæcum and the appendix becomes twisted upon its mesentery. Then when the cæcum returns to its normal position tenderness, pain and nausea may begin immediately and at operation the appendix will be found to be in a condition of torsion of the mesentery, due to a sequel of the blow rather than to direct injury from the blow itself. The most important question in the way of differential diagnosis was whether these ganglia of the sympathetic nervous system were sensitive on both sides of the navel, on both right and left or only on the right side, meaning chronic appendicitis.

In regard to appendicitis in young children, Doctor Morris did not hear anything in the paper about lymphatic hyperplasia which will include a definite percentage of every hundred cases in which a diagnosis is made of chronic appendicitis in children. All five kinds of chronic appendicitis may sometimes cause nausea and abdominal tenderness. These cases all present the symptom of hypersensitiveness of the fused ganglia on the right side only and also the second important diagnostic sign, chronic distention of the ascending colon, with high pitched percussion note. These two signs are all that we require for accurate differential diagnosis in cases of chronic appendicitis. Both signs are absent in acute appendicitis.

DR. SEWARD ERDMAN remarked that there is one type of case which he felt deserved more emphasis than Doctor Peterson had given it; namely—acute mesenteric lymphadenitis—usually occurring in young children—and closely simulating acute appendicitis. He happened recently to have seen two of these cases in children, one seven and the other nine years of age, where the preliminary diagnosis was that of acute appendicitis. Careful examination showed some of the symptoms were not present but there was vomiting, slight leucocytosis and tenderness in the right side of the abdomen at and above umbilicus. In each case, although there was some question as

## AFFECTIONS OF THE APPENDIX IN YOUNG CHILDREN

to the diagnosis of appendicitis, operation was demanded by the parents, and in neither case was acute appendicitis found; there was acute mesenteric lymphadenitis. In both these cases the child had a history of a slight cold preceding the symptoms of appendicitis. Several articles have been written in the last few years citing cases of this sort. This is something to be borne in mind for if these cases can be recognized operation will not be necessary, although it is safer to operate when in doubt.

DR. NATHAN W. GREEN thought it impossible to never make a mistake in diagnosis; anyone at operation might be likely to find a fishbone in the bowel instead of a pin in the appendix. All possibilities have to be considered. There was one thing Doctor Peterson had apparently not mentioned and that was the possibility of the pain being due to an early beginning Pott's disease. It seemed to the speaker the only way to be surest of a diagnosis was to follow the plan outlined in lighter vein by Doctor Moschcowitz at one time; that is, to have the house surgeon, junior and senior internes and the attending surgeon each make a diagnosis. Out of the four one ought to be right. It seemed to Doctor Green that if one waited to make a sure diagnosis, especially one not over-familiar with this condition, one might wait too long and so do the patient more damage than by operating on an unsure but probable diagnosis and removing a normal appendix.

DOCTOR PETERSON, in closing the discussion, replied to Doctor Morris, that there was no special tenderness at "Morris's point," in the child with the ovarian cyst. The point of maximum tenderness, as he stated in his report, was just above and to the right of the pubis, almost in the mid-line. The differential points between appendicitis and pelvic disease, mentioned by Doctor Morris, did not hold good in this case.

"Lymphoid hyperplasia" was the pathological diagnosis given in two of Doctor Peterson's cases. Later the pathologist reviewed the sections in these two cases and changed the diagnosis to "healed appendicitis" in one instance, and to "chronic appendicitis" in the other.

Replying to Dr. Seward Erdman, he stated that there were several cases of mesenteric lymphadenitis in his series. The appendix was removed in these cases and showed definite pathology in every instance. Mesenteric lymphadenitis cannot be recognized with certainty before operation.

As to what special treatment he employed in cases of peritonitis, Doctor Peterson stated that he had no routine plan of treatment, except to follow in a general way the principles laid down by Murphy, Fowler, Ochsner, etc. The appendix was removed at operation, if it could be located and taken out without too much difficulty, fluid exudate was aspirated away, and drainage was provided for. Following operation it was important to introduce fluids into the system by retention enemata or the Murphy drip, and by frequent clyses or intravenous infusions, and occasionally by a blood transfusion.

Enterostomy had been employed in but two cases in the reported series and both terminated fatally. Doctor Peterson had done a jejunostomy or

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enterostomy in a number of his older cases of appendicitis with peritonitis, and he felt that, in his experience, it did no good in peritonitis *per se*, and was of benefit only when mechanical intestinal obstruction was present. In the case of an older child (not included in his report) who had an attack of acute appendicitis, with rupture of an abscess into the bowel and the evacuation of a large amount of pus per rectum, followed later by a gradually developing adhesion obstruction of the intestine, a jejunostomy had proved to be a life-saving measure.

Doctor Peterson said, when operating for right inguinal hernia, it was interesting in taking the history, to go into the question of pain in the right lower abdomen, as such a large percentage of hernia patients showed definite pathological changes in the appendix. It was Doctor Peterson's rule to examine the appendix, when operating for hernia of the right side, and to remove it if it showed any evidence of disease. Mesenteric kinks or deforming adhesions, which interfered with drainage of this organ, were also indications for the prophylactic removal of the appendix.

Doctor Green had spoken of Pott's disease as being overlooked by the speaker in discussing the differential diagnosis of appendicitis. He had mentioned psoas abscess, but had failed to dilate on the early symptoms of Pott's disease.

STATED MEETING HELD OCTOBER 24, 1928

The President, DR. FRANK S. MATHEWS, in the Chair

### STRANGULATED OBTURATOR HERNIA

DR. RICHARD W. BOLLING presented a woman of seventy-seven years, who, when seen on the morning of April 14, 1928, gave a history of persistent vomiting and obstipation for three days. The vomitus was feculent and there was only moderate abdominal distention. She was obviously suffering from intestinal obstruction, apparently involving the small intestine. The patient was removed to St. Luke's Hospital where Doctor Bolling operated on her. A right rectus incision under local anæsthesia revealed a collapsed terminal ileum. The collapsed gut was followed to the left side of the pelvis at the site of the obturator foramen, where a loop of intestine was caught in a pocket, probably between the external and internal obturator membranes. At this stage open ether was administered. The edge of the opening was well defined, sharp and apparently slightly curved. An attempt was made to dilate the opening by pressure on this edge. Then by gentle traction, first on the collapsed and then on the distended loop of intestine, a strangulated loop of ileum was delivered. This portion of intestine was not viable and twelve centimetres was resected with immediate end-to-end anastomosis. Convalescence was complicated by infection of the wound. The patient is now in excellent health with a soundly healed wound.

### PARTIAL GASTRECTOMY BY BILLROTH NO. 1 METHOD

DOCTOR BOLLING presented a man of sixty-eight years, who was admitted to St. Luke's Hospital December 9, 1927. The history was that of stomach



#### PARTIAL GASTRECTOMY BY BILLROTH NO. 1 METHOD

trouble for thirty-five years. During the past year the pain had become almost unbearable. There was an irregular, firm, freely movable mass in the epigastrium. Röntgenographic examination of the gastro-intestinal tract revealed definite evidence of defect in the pyloric region with twenty-four-hour retention. Under regional anæsthesia the pyloric portion of the stomach was



FIG. 1.—After partial gastrectomy by first Billroth method. Röntgenogram following opaque meal.

resected and direct union of the stomach and duodenum effected. There was an ulcerated tumor, involving the greater curvature of the pyloric region. The pathological report was a highly destructive and infiltrating adenocarcinoma of the stomach. Convalescence was uneventful and the patient was discharged four weeks after operation. He was subsequently readmitted to the medical service with a complaint of pain in the back and sense of weight in the legs. The diagnosis was metastatic carcinoma. Röntgenographic

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examination of the lumbar spine showed marked osteo-arthritic changes. After a short course of radiotherapy the patient was discharged. At the present time he is much relieved and has gained twenty-five pounds since his



FIG. 2.—Carcinoma of pyloric portion of stomach. Röntgenogram after opaque meal before operation.

operation. His appetite and digestion are good and his only complaint is of pain in joints and back aggravated by changes in weather.

DOCTOR BOLLING presented also a man of fifty-two years, who was admitted to St. Luke's Hospital January 1, 1928. He had suffered with epigastric pain for fifteen years; recently there had been severe pain one and a half

## PARTIAL GASTRECTOMY BY BILLROTH NO. 1 METHOD

hours after meals, unrelieved by food. During the past six weeks he had vomited bitter greenish fluid. He had lost ten pounds in five weeks. The patient appeared in moderately good condition. There was a hard, tender, movable mass in the epigastrium apparently connected with a dilated stomach. Examination by opaque meal showed a pyloric defect with large twenty-four-hour retention. Operation, delayed for some days on account of high

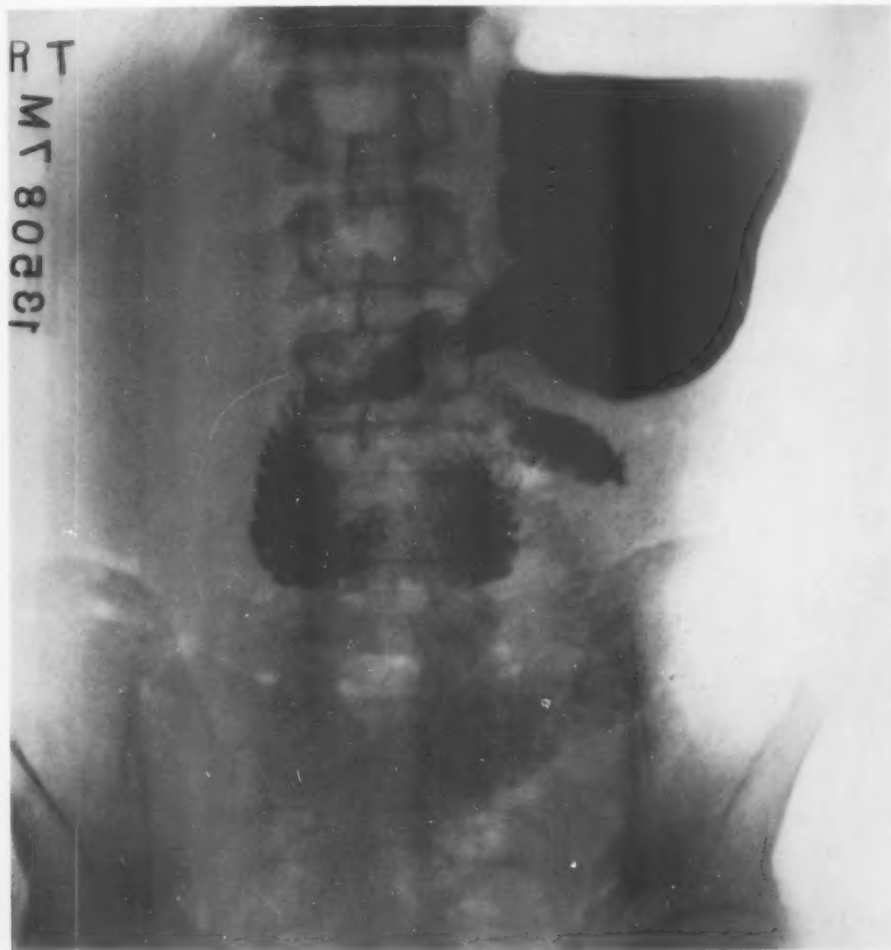


FIG. 3.—Same case as in Fig. 2 after operation. Partial gastrectomy by first Billroth method. Röntgenogram after opaque meal.

urea nitrogen retention and low phenolphthalein excretion, was undertaken January 14. A carcinoma of the pyloric region was found. Partial gastrectomy with direct union of stomach and duodenum was done. The pathological report was adenocarcinoma involving lesser curvature of the stomach just proximal to pyloric ring. Convalescence was uneventful. Patient is apparently in excellent health at the present time and has gained forty pounds in weight.

DOCTOR BOLLING presented a third patient, a man of forty-three years, who was admitted to St. Luke's Hospital May 14, 1928. His history dated

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from September, 1927, and was of gaseous eructations, accompanied by burning pain in the epigastrium, unrelieved by food. He had vomited frequently and had lost thirty-two pounds in weight. He was emaciated and dehydrated. There was deep tenderness in the epigastric region but no mass could be made out. The hæmoglobin was 70 per cent. and the Wassermann

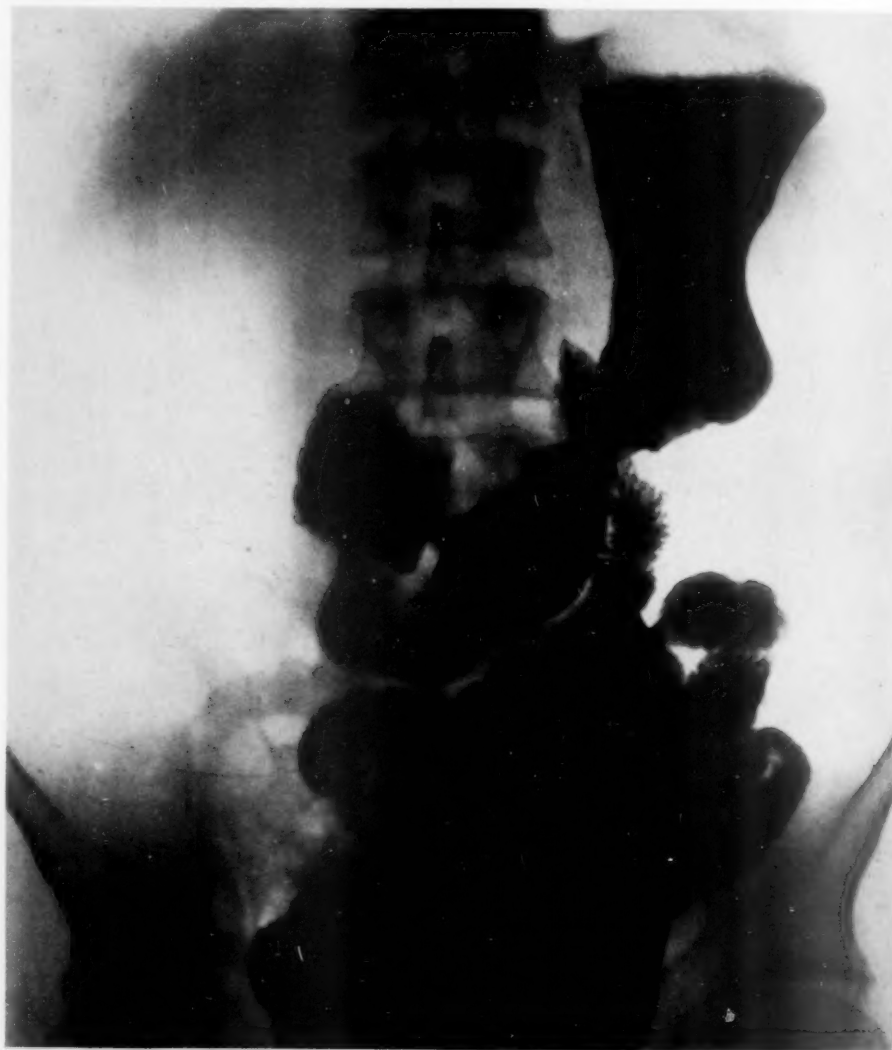


FIG. 4.—Chronic ulcerative gastritis in a luetic patient. Before operation.

reaction was strongly positive. Examination with the opaque meal revealed a filling defect in the pyloric portion of the stomach with a resulting hour glass deformity. He was treated in the medical wards for one month without improvement. Doctor Bolling operated June 14, 1928. On opening the abdomen the stomach appeared smooth save at an area 5 cm. proximal to the pyloric ring where there was puckering of the anterior wall. The stomach wall felt thick but no crater could be made out. An opening was made in the stomach proximal to the thickened area and a contraction which just

PARTIAL GASTRECTOMY BY BILLROTH NO. 1 METHOD



FIG. 5.—Same case as in Fig. 4 after operation. Resection of pyloric portion of stomach with direct union of stomach and duodenum. Röntgenogram after opaque meal.



admitted the tip of the little finger was found. A definite diagnosis could not be made at this time. The indication, however, seemed clear and the pyloric end of the stomach was resected and the cut end of the stomach was united directly to the duodenum.

*Pathological Report by Doctor Knox. Macroscopic.*—Specimen consists of a pylorus and distal 8 cm. of the stomach. The pylorus is normal in size and thickness. Four cm. above the pylorus there is a circular constriction in the wall of the stomach which reduces the lumen to the diameter of 1 cm. Above, the circumference of the stomach is 8 cm. and below 4.5 cm. The constriction appears to be caused by thick fibrous tissue. On either side of the stricture the mucosa is ulcerated for a distance of 2 cm. The ulcer is shallow and the edges are low. There is no gross evidence of tumor.

*Microscopic.*—Sections show a portion of ulcer which is small with necrotic edges and scarcely any evidence of hyperplasia. There is a slight dilatation of the mucous glands in a few areas. Much of the surface in the section is not ulcerated but all of it is inflamed. This mucosa is oedematous and infiltrated with eosinophiles, plasma cells and lymphocytes. The submucosa is very greatly thickened by a fairly cellular fibrous tissue in which there are localized areas of lymphoid infiltration. The muscle is fairly well preserved but shows a chronic inflammation with numerous eosinophiles, lymphocytes, and plasma cells, throughout all coats. These extend along the course of the blood vessels with some new tissue. The subserous layer is also considerably thickened. There is no marked perivascular infiltration although some of the small veins show infiltration of the adventitia and possible thickening of the wall. The lesion, however, is not a prominent one in any of the vessels. There are more lymphocytes than plasma cells. It is, therefore, impossible to designate it as a syphilitic lesion. Diagnosis, chronic ulcerative gastritis.

Convalescence was uneventful and the patient is now in good health, having gained twenty-five pounds. The Wassermann remains positive. He has not had systematic treatment since he left the hospital.

DR. NATHAN W. GREEN said that he had been encouraged to follow the same method in a few cases and to modify the Billroth No. 1, as he thought Doctor Bolling had done, by the Horsley method, cutting down the front of the duodenum and making a larger stoma than otherwise could be made. He has seen very good results in some of Doctor Bolling's cases and showed one here, himself, last spring that had gone about a year which had been X-rayed afterward, and which had been done by this method for carcinoma of the prepyloric segment. He saw the woman today in a follow-up and she was still doing very well and was gaining right along in weight, and had a good color. It seemed to him that this method, if it could be done as Doctor Bolling had done it, with discrimination, was a favorable method for repair after partial gastrectomy. Removing the pylorus is what Doctor Green said he had done in all his cases; he did not know whether Doctor Bolling had or not, but presumed he had. If the cases were free from tension when finished and a little omentum placed around the suture line, he thought, barring hæmorrhage into the stomach and barring a certain percentage of shock, one could be quite satisfied with the work done in cases after this manner.

DR. HERMAN FISCHER said that the Billroth No. 1 for some years had been his favorite method for resection of the stomach in cases of ulcer or carcinoma. He employed it, however, only in cases in which there was no tension and in which the mobilization of the duodenum was easily accomplished without getting into conflict with the biliary passages. The operation

## TENDON TRANSPLANTATION

appealed to him because it leaves the outlet of the stomach where it belongs physiologically. In Europe this operation has found more favor with surgeons than in the U. S. A. The speaker had thus operated on ten or fifteen patients until he had an experience which was startling. The patient, a young man of about twenty-four years old, had been suffering from an ulcer of the duodenum and stomach for a long time and was in consequence very much run down. A resection after Billroth No. 1 was done. The patient did very well and his recovery was smooth until the seventh day after the operation, when he suddenly collapsed. On examination an acute dilatation of the stomach was found. An immediate lavage was done, but without result. He therefore reopened the wound for exploration and found, beside a tremendous dilatation of the stomach, also a considerable dilatation of the first and second portion of the duodenum. There was absolutely no mechanical obstruction. The anastomosis was perfect. The patient did not rally and died three hours later. At the autopsy no explanation for this dilatation could be found. There have been reported several cases of acute dilatation of the stomach after Billroth No. 1 resection. One case was reported by Konjietzny who believes that this condition is caused by a paralysis of the splanchnic nerves.

DOCTOR BOLLING, in closing the discussion, said that in his opinion the original Billroth method of partial gastric resection may be used with advantage in properly selected cases. Where the anatomical conditions are favorable, this type of operation seems to be the simplest of all methods. In his cases union of the stomach with the duodenum was effected at the greater curvature and no attempt was made to enlarge the duodenum by plastic operation. In presenting the first two patients he emphasized his belief in the value of partial resection of the stomach for carcinoma when practicable in advanced cases as a palliative measure. No one who saw these two men ten months ago and again tonight could consider them as anything but satisfactory results. The infrequency of permanent cure in such cases should not be used as an argument against partial gastrectomy.

## TENDON TRANSPLANTATION

DR. HUGH AUCHINCLOSS presented a man, thirty-four years of age, a surgeon, who, in December, 1927, received an abrasion in the distal flexion crease of his right forefinger. Thinks he got some infection in it when he operated on an abscess. The same night it began to throb and two days later he apparently had a suppurative tenosynovitis of his digital sheath. For this he had had eighteen operations on his finger and palm. He finally came to see whether he could get anything done to give him function in his proximal interphalangeal joint.

The distal interphalangeal joint was quite ankylosed. The metacarpophalangeal joint, though it had been infected and some of the base of the proximal phalanx destroyed, had motion, though the motion was not normal inasmuch as the phalanx was somewhat subluxated. The proximal interphalangeal joint was normal. The scarred ends of the flexor tendons lay half way down the palm. There was practically no tendon distal to this and there was very little tissue available for the construction of bridges; or phalangeal annular ligaments, to keep transplanted tendon from prolapsing.

May 2, 1928, two incisions were made—one in the proximal flexion crease of the palm, the other along the outer side of the finger with a cross incision along the distal flexion crease. This left a short bridge of tissue between them in the palm. The flexor tendons were freed and the sublimis made to perforate the profundus in two places and sutured in place with fine silk. The palmaris longus tendon was exposed in the forearm and one-half of it removed and, after ligation of its proximal end by transfixion with a silk suture so that it would not split all the way, divided. This removed half of the tendon was then split its whole length into two parts except where it had been ligated off at the end. One limb of the transplant was then drawn between the sublimis

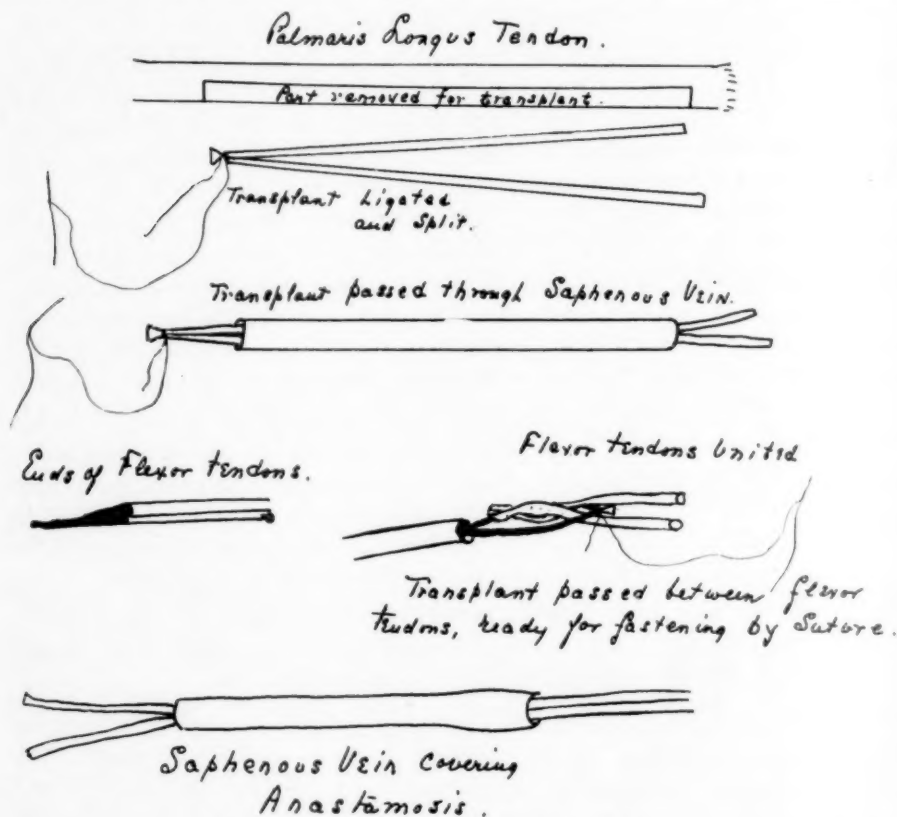


FIG. 1.—Case of Infected Finger.

and profundus above where they had been made to perforate one another and sutured in place. A piece of the internal saphenous vein was then excised, washed out with saline and the two ends of the transplant passed through it. The vein was drawn over the ends of the flexor tendon and the end of the transplant they enclosed, thus providing a smooth surface coating over the anastomosis. Transplant and vein were passed close to the bone and metacarpophalangeal joint into the finger beneath as much tissue at the base of the finger as could be saved to act as an annular ligament. The distal ends of the transplant were then laced into the base of the distal phalanx and the wound closed with very fine sutures. All traction on the transplant and weaving of the tendons were readily accomplished by means of a very delicate instrument we call a "scissor clamp" made expressly for the purpose of weaving fascial

## TENDON TRANSPLANTATION

transplants. All silk sutures passed through the tendons to their surface were passed back through their point of exit in a different direction so that practically no suture was seen on the surface of the tendons. The operation took two hours and twenty-five minutes. An Esmarch tourniquet outside three towels folded six ply was used about the arm above the elbow. The anæsthetic was ethylene oxygen. During the whole operation his respirations were deep, stertorous, vigorous and partially obstructed. At many times he became deeply cyanosed and the administration was an exceedingly difficult one. The after wound healing was quite uneventful. There was no infection nor hematoma.

On being questioned after coming out of his anæsthetic it was found his fingers and hand were anæsthetic, but that he still retained some sensation in his forearm. He had no power in his hand and forearm muscles whatever. The question arose whether any operative treatment directed toward exposing the median ulnar and musculo-spiral nerves at or above the site of the tourniquet was indicated in case hæmorrhage in and about their fibrils had taken place. After consultation with Doctors Whipple and Casamajor, who both offered an encouraging prognosis, it was decided to do nothing by operation. Seven weeks after operation he began moving his fingers slightly. Sensation had begun to return somewhat sooner.

Four months after operation the palmar incision was opened, the tendon anastomosis exposed and completely freed from adhesions in the palm and the skin sutured again. The anastomosis was smooth, glistening and even throughout. No suture could be seen. The vein had apparently become one with the tendon and aided in providing a smooth surface but not as a sheath.

He had quite regained his muscular power. He could flex his proximal interphalangeal joint but did so with difficulty, partly because of the subluxation of his metacarpophalangeal joint and partly because a slight prolapse of the transplanted tendon due to absence of good tissue for making an annular ligament caused a mechanical disadvantage. It is possible, too, that the tension of the transplant was not enough. If his proximal phalanx be held extended and fixed at the metacarpophalangeal joint his proximal interphalangeal joint motion is almost normal. He is shown because of

(1) The multiplicity of operations done.

(2) The paralysis and anæsthesia caused by the tourniquet. The speaker has used this form of tourniquet on a considerable number of cases during the past fifteen or twenty years. Never before, when towel padding has been used, has there been any trouble. He has felt that the technic provided a safe way for using such a tourniquet. Because of this case he must change his opinion. Why such a difference should have occurred in this instance is the question. That the intense venous congestion he was submitted to played a part seems plausible. If at the point where the circulation is inhibited no undue changes occur in the circulatory balance save that caused by the pressure the tissue cells in that immediate neighborhood will suffer but little damage. If, however, intense passive congestion, in every tiny venule and its larger outlets is done to return flow already slackened by a diminished arterial supply, hæmorrhage into the tissue spaces should take place and the cells be more than temporarily deprived of their circulatory mechanism due to the annihilation of the return flow conduits. The speaker has used such a tourniquet on an arm over three hours more than once and in one case over four hours with no ill effect whatever. Should any case, however, with a tourniquet applied become badly congested from the anæsthetic, it may be wise to loosen the tourniquet and leave it off entirely, or replace it for short periods at a time.

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(3) The paralysis began to clear in seven weeks. The vein provided no sheath but did provide a beautifully smooth covering for the tendons at the site of anastomosis.

(4) If no annular ligaments can be fashioned one is at a great mechanical disadvantage.

(5) In estimating the function of a finger tendon transplant a deformed metacarpophalangeal joint may interfere with an otherwise good result.

(6) Would ankylosis of his metacarpophalangeal joint provide him with such good motion in his proximal interphalangeal joint as to make it worth while, or is the problem more that of tendon prolapse? Would ankylosis lessen the prolapse as well?

(7) The palmaris longus tendon is useful for tendon transplant.

(8) By weaving tendons together and burying the silk sutures an immediately stronger anastomosis can be depended on so that early motion can be begun with more assurance than when the suture alone method is used.

(9) Weaving even fine tendon strands as well as large fascial strips are greatly facilitated by the use of the scissor clamp instruments.

(10) Transplantation reconstruction of finger tendons that has sloughed or become adherent is feasible, but requires favorable conditions and niceties of technic.

DR. DEWITT STETTEN spoke of a case he presented before the Society a year ago in which he had performed a resection and reconstructive arteriorrhaphy for brachial arteriovenous aneurysm. An Esmarch bandage without an underlying towel had been applied just above the elbow and had been left in place for about fifty minutes. After the operation a flaccid paralysis of the entire forearm and hand developed somewhat as in Doctor Auchincloss' case. This was diagnosed by the neurologist as an ischemic paralysis, but because of the complete absence of sensory disturbance, the total unselected paralysis of all the muscles of the forearm and hand with no interference in the Faradic response, and the rather sudden, complete recovery without any atrophy whatsoever about three weeks after the operation, Doctor Stetten felt that this paralysis might have been of an hysterical character in spite of the apparent loss of the reflexes.

### INFLAMMATORY DISEASE OF THE MESOCOLON RESEMBLING CARCINOMA OF THE SPLENIC FLEXURE

DR. HUGH AUCHINCLOSS presented a man, twenty-eight years of age, who came to Presbyterian Hospital, July 23, 1919, with a story that he had had his appendix removed six weeks previously in another hospital, following abdominal pain and vomiting. The wound was drained. Since the operation he had had persistent pain referred to his right side, some temperature, and a fairly marked secondary anemia. Red blood cells 3,200,000, hæmoglobin 60 per cent., leucocytes 8,000, polymorphonuclears 60 per cent., lymphocytes 40 per cent. His temperature remained normal while in the hospital, his right diaphragm was slightly high but otherwise his examination was negative. One month after his discharge he felt well and was back at work.

About eighteen months later, September 9, 1921, he returned. This time he had had chilly feelings, malaise, muscle and joint pains and sore throat for three weeks and for a fortnight, sharp dragging pains in his left lumbar region that radiated to his left lower abdominal quadrant and into his left chest. His blood showed a mild anemia, red blood cells 3,600,000, hæmo-



## INFLAMMATORY DISEASE OF THE MESOCOLON

globin 80 per cent., leucocytes 8,000, polymorphonuclears 62 per cent. His physical examination was negative save for a mass of considerable size, movable on bimanual examination but not movable with respiration, situated on the left side of his abdomen and flank. Pyelograms and barium enema showed nothing abnormal in kidney or in colon. The kidney shadow was seen just above the splenic flexure, the cæcum was dilated, but there was no sign of obstruction, and the "tumor mass is certainly not connected with the colon." Tympany was evident on colon inflation, over the mass. The urine was negative for tubercle bacilli. After ten days' observation the mass seemed smaller, very hard, not tender. Because the left ureter, on catheterization, showed a little blood, which was found in mixed urine subsequently, a hypernephroma was considered possible.

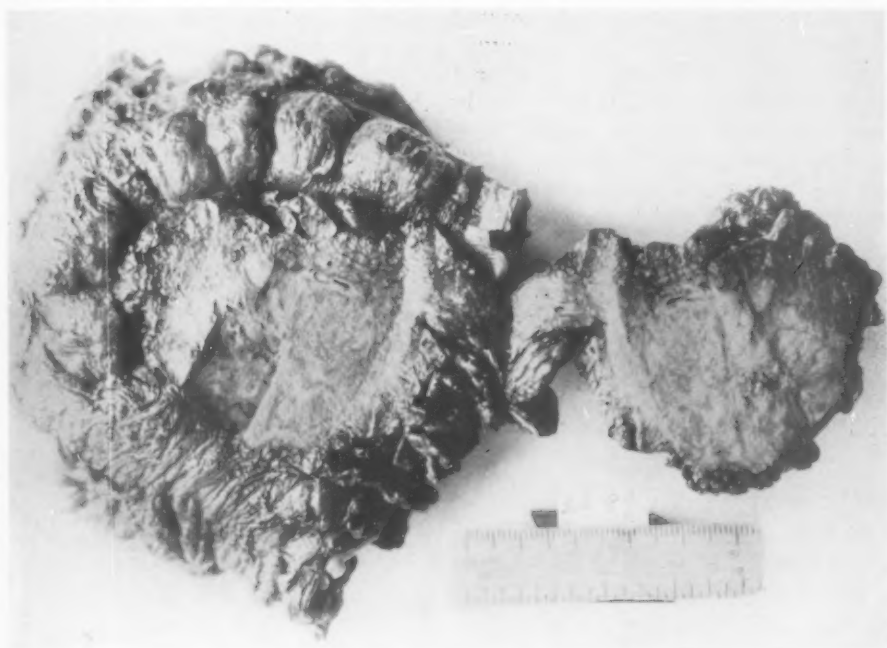


FIG. 2.—Disease of Mesocolon. Photograph of specimens removed.

May 14, 1921.—Seven and a half years ago he was operated on. First the left kidney was explored through an oblique kidney incision and found normal. The mass was found to be intraperitoneal. A left rectus incision was then made. A mass eight to ten centimetres in diameter was found in the mesocolon binding the distal part of the transverse colon to the middle of the descending colon with the splenic flexure above. It was very hard, nodular and inseparable from the two loops of colon and attached to the postero-lateral abdominal wall. Thinking it either tuberculous nodes or cancer of one of the loops of colon a resection was done, removing an appreciable amount of the lateral abdominal wall, half the transverse and most of the descending. An end-to-end anastomosis was done, by clamping with Kocher clamps, resecting with cautery close to the clamps and taking two seromuscular rows of sutures on either side of the clamps and withdrawing them just before the last sutures were taken and tied. This is practically an aseptic method of anastomosis well adapted to the large gut. In

dissecting the mass from the posterior abdominal wall, the left ureter was isolated and the mass dissected away from it. For a short distance the ureter was rather conspicuously surrounded by chronic inflammatory tissue. The wound was drained. The pathological examination showed the mass to be made up of chronic inflammatory tissue with the colon walls inseparably adherent to it. Lymph nodes were not seen in the mass though there were several enlarged in the neighborhood. No tuberculosis.

After five anxious days of colic and gas pains his gut functioned properly and in spite of distention and colon irrigations no evidence of any faecal discharge occurred till the eighth day. This was slight and after the sixteenth day ceased entirely. On the twenty-fourth day he went home.

He returned in July of the same year, about two months later, for drainage of an abscess in his kidney wound. This wound had been made to communicate with his abdominal wound and drainage had been too restricted through that route. Since then he has remained well as far as his large intestine is concerned, but is now under observation and treatment for a small ulcer showing a crater in the first portion of his duodenum.

The reasons for presentation of this case are:

- (1) Because of its diagnostic difficulties. Probably such a case cannot be diagnosed. Blood from the left ureter due to an inflammatory process in its neighborhood is always misleading.
- (2) Difficulty of telling what the mass was when exposed at operation.
- (3) Unusual occurrence of a large, chronic inflammatory process in a mesocolon binding the colon loops together with no demonstrable pathogenesis.
- (4) Method of end-to-end anastomosis with satisfactory function seven years later.
- (5) Similarity of the mass to carcinoma, in the gross.

DR. ALLEN O. WHIPPLE said he had seen this type of lesion which so closely resembles carcinoma. Two years ago he had a patient, a woman of sixty years of age, who was brought to the hospital with complete obstruction of the bowel. Because of the history and the fact that no bowel movement or gas had been noted for a period of six or seven days it was believed that the obstruction was rather low down and because of her poor general condition nothing was done but a cecostomy which removed the acute obstruction. At the end of seven or eight days thereafter she was given a small amount of barium and the obstruction was demonstrated to be in the region of the splenic flexure. A barium enema showed complete obstruction at that point. At operation the process causing the obstruction was quickly found and in the gross it had all the appearance of an annular scirrhus carcinoma of the splenic flexure. The patient was an obese woman and presented difficulties in making an incision on the left side. Because of the great difficulty that would have been encountered in attempting an end-to-end anastomosis, and because of the fact that the lesion was at the juncture of the splenic flexure and the pelvic colon, the lower end was inverted, the splenic flexure and the tumor brought out and a permanent colostomy established. That afternoon the specimen was demonstrated by the pathologist to the students as a typical case of scirrhus carcinoma of the bowel. Very surprisingly, however, no evidence of carcinoma was found in the laboratory; it was fibrous tissue and

## NECROSIS FOLLOWING RADIOTHERAPY IN BREAST CARCINOMA

seemed to be the remains of a diverticulum which apparently had caused this tremendous connective tissue annular ring with contraction and complete obstruction of the lumen of the bowel.

These cases, though rare, do appear. They have to be treated as carcinoma because it is inadvisable to take a piece out of the bowel in order to determine the diagnosis. The diagnosis of carcinoma is sometimes not corroborated in the laboratory and the only thing to fall back on is a statement to the family, as was done in this case, of a perfectly good prognosis as far as carcinoma is concerned.

DR. EDWIN BEER said that these inflammatory diseases of the mesocolon in his experience have usually been associated with colonic diverticulitis or with foreign body perforation from the bowel into the mesocolon, both conditions resembling each other very closely. The diagnosis in these cases is at times most difficult, especially when the inflammatory mass lies directly in front of the kidney simulating a renal neoplasm. In some of these cases a pyelogram satisfactorily rules out the kidney condition, but every once in a while, for some reason or other, a pyelogram cannot be made and pre-operatively an accurate diagnosis is impossible. In a recent case where a large mass presented in the left loin and iliac region which was ballotable like a large kidney mass, it was impossible to get a pyelogram to exclude a renal condition, and at operation the kidney was found normal but on exploring anteriorly, a fish-bone was encountered lying in some thick pus with extensive firm exudate in the mesocolon. These foreign body perforations had recently been collected at Mt. Sinai Hospital by members of its staff, and put on record. They presented a very interesting group, and though less frequent than the group of diverticulitis cases, they should always be borne in mind with these mesocolon exudates.

DR. FRANK S. MATHEWS referred to a man pretty well along in years who had a history of partial obstruction at the splenic flexure. Röntgenograms showed a small amount of fluid in the chest, the left diaphragm entirely fixed and immovable. He was operated on with the idea of encountering carcinoma, and at operation it was thought to be carcinoma. Because of the presumed extension to the chest resection was decided against but anastomosis between the transverse and descending colon was done. That was six or seven years ago and a few months ago the patient was reported to be in good condition. This was probably one of those inflammatory conditions often mistaken for carcinoma.

DOCTOR AUCHINCLOSS, in closing the discussion, said that pathological examination of the mucous membrane showed no evidence of ulceration, nor of diverticulitis. All of the mucosa was smooth. This, of course, did not rule out a former perforation or diverticulitis, but it made it most unlikely. No foreign body was found.

## NECROSIS FOLLOWING RADIOTHERAPY IN BREAST CARCINOMA

DR. HUGH AUCHINCLOSS presented a woman, who was referred to him in April, 1918, on account of a small, firm, painless mass in the upper

outer quadrant of her right breast which she had noticed for the previous three months. X-ray and clinical examination showed no evidence of metastases elsewhere and the axillary nodes showed no clinically suspicious nodes. A very extensive fascial dissection with wide skin removal of the left breast was done, removing the pectoral muscles, rectus sheath and axilla and undermining close to the skin far and wide.

The pathological examination showed a very definite carcinoma. The axillary glands were not involved. The carcinoma cells showed differentiation and in some places acinar architecture. Her course was not unusual and she went home on her seventeenth day with a prognosis estimated more favorable than the average. She was quite lost sight of for six years when she was again located. From June 6, 1918, to April 4, 1919, she received eighty-nine radiation treatments through aluminum, bakelite, and leather filters that were in use at that time.

About seven years after the operation a small area in the scar began to show necrosis. Over the whole radiated surface were skin telangiectases. This necrotic spot enlarged to a diameter of about seven centimetres and occupied most of the upper part of the chest scar over the second and third rib. The whole area was excised and Thiersch grafted. The grafts took over the greater part of the surface. Two months later the residual granulating places were excised and grafted.

Two months later, May, 1926, the costal cartilages and portions of the second and third ribs were removed, the wound left open, and heat applied over saline dressings. The wound epithelialized from previously grafted areas without further grafting.

In 1928, two years later, the lower end of the scar of lower part of the wound began showing necrosis.

April 21, 1928, part of the fifth and sixth ribs and a considerable portion of the common costal cartilage with intercostal tissues between was removed over the cardiac area, and Thiersch's skin grafts applied over part of this pulsating wound. The grafts have grown and now, six months later, they cover the denuded area with the exception of a tiny bit of exposed cartilage below.

She is presented for the following reasons:

(1) A case of cancer of the breast who, though remaining free of her disease, is still under treatment from the results of treatment.

(2) The late appearance of the radiation dermatitis. Seven years or considerably longer time may elapse before ulceration depending somewhat on the age and nutrition of the patient. Of course many X-ray dermatitis cases show necrosis in far shorter periods, of days or weeks.

(3) The need in this case for extensive cartilage, bone and chest wall removal before skin grafting sufficed.

(4) How X-ray exposure seems to put a reproductive quietus on the cells beneath the skin in such a case.

(5) As a warning to all advising the use of radiotherapy.

DR. DEWITT STETTEN related an experience very similar to that of Doctor Auchincloss in regard to the late effects of radiotherapy. The patient was a woman who had had an epithelioma of the chin which had been given X-ray and radium therapy at various times over a period of thirteen years. The growth then became uncontrollable and more radical surgical measures became necessary. Some time later, more than two years after the last X-ray treatment, and some fifteen years after the beginning of the treatment, the

## NECROSIS FOLLOWING RADIOTHERAPY IN BREAST CARCINOMA

FIG. 3.—Photograph taken seven years after her operation and radiotherapy, with necrosis over second and third ribs.



FIG. 4.—Photograph taken nine years after her operation, showing necrosis over fifth and sixth ribs and costal cartilage.





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patient suddenly developed a necrosis of the inferior maxilla, very much like that resulting from phosphorus poisoning. This resulted in a complete sequestration of the entire left half of the mandible, including the coronoid and condyloid processes, and a part of the horizontal portion of the right side. He emphasized the possibility of this danger in protracted irradiation of the lower portion of the face.

DR. EDWIN BEER said that late necrosis following X-ray and radium therapy was a well-recognized clinical entity. It was of some interest to see such a late necrosis in an area in which the vascularization was so well marked as in the case described by Doctor Auchincloss. In avascularized surfaces such as are seen after radiation, one would expect occasional ulcerations. Doctor Beer himself has seen a number of late ulcerations following X-ray and radium, the latter in the bladder following radium in the cervix, and the former on the surface of the body. The radium cases had recently been discussed rather extensively before the G. U. Section of the American Medical Association in Washington in 1927. In one case where the late destruction developed from X-ray therapy, the skin over the trochanter of the femur broke down and carcinoma developed extending into the femur, producing osteomyelitis many years after exposure to therapeutic X-ray doses. In view of these late developments, it is well worth reminding the profession of these possible calamitous effects.

DOCTOR AUCHINCLOSS, in closing the discussion, said he might have given a wrong impression about the vascularity of the case. Though it appeared to have considerable vascularization because of the many telangiectases, it did not have any blood supply at all and almost all the chest wall down to the pleura had to be removed before a surface could be obtained that showed enough blood supply to make skin grafting feasible.

### CARCINOMA OF THE TRANSVERSE COLON AND CARCINOMA OF THE CÆCUM

DR. JOHN F. ERDMAN read a paper with the above title for which see page 54. In connection with his paper he presented the following patients:

CASE I.—Male, forty-four years old. When first seen was suffering from an almost complete obstruction. Has had colicky pains centring chiefly about the mid-upper abdomen. X-rays taken showed a very characteristic involvement of the mid-transverse colon.

*Operation.*—Mikulicz, on November 6, 1916. Completed December 19, 1916.

No evidences of recurrence or metastasis until January, 1924, eight years later, when he began losing ground—secondary anæmia and constant ache in the right lower quadrant. Loss of weight. *Examination.*—Palpable mass on cæcum.

*Operation* February 9, 1924.—Friedrich's operation with side-to-side anastomosis. *Pathology.*—Adenocarcinoma.

CASE II.—Endometrioma, followed by transverse carcinoma. Female, twenty-nine years old. First seen March 30, 1927. Operation three years ago for a "rupture or bloody cyst" of right groin. Operation two years ago for ovarian cyst, side not known. Now has pain in right groin at menstrual

## CARCINOMA OF THE TRANSVERSE COLON AND OF THE CÆCUM

period and has a hard growth in the groin. No examination was made of the bloody cyst removed three years ago.

*Examination* reveals irregular scar in femoral region with a very hard and exceptionally tender mass about the size of a large peanut kernel. *Advised.*—Operation if the pain became unbearable or if the lump should grow.

October 3, 1927.—Seven months later seen the second time, the growth was fully three times its original size. Now resembles a fibrosarcoma, well-fixed. Removed October 14, 1927.

*Pathological Examination.*—Recurrent adenofibroma with endometrial implantation.

*X-ray Treatment.*—No recurrence at this site up to death.

January 10, 1928.—A complete obstruction developed. X-rays showed all the evidence of carcinoma of the transverse colon.

January 12, 1928.—Mikulicz, first stage, was done. In about fourteen days a severe hæmorrhage took place following the use of an enterotome some eight days before. Patient transfused, with recovery. Final closure of the opening in the transverse colon done February 10, 1928.

April 4, 1928.—Many metastases. Died in June. More careful search revealed endometrial tissue in the carcinomatous ovary.

CASE III.—Male, fifty-six years old, first seen April 17, 1922. Since seventeen years of age, *i.e.*, thirty-nine years, had dysentery with blood, evidently an unrecognized case of polyposis coli. At twenty-three years of age, or thirty-three years before being seen by Doctor Erdmann, was operated upon for obstruction, a sigmoidostomy being done. Relief of his obstruction but not of his dysentery. After fifteen years of treatment by washings, etc., control enough was obtained to allow him to sleep all night.

1918.—Had a severe diarrhœa. 1919.—Fair amount of discharge from the rectum. 1920.—More discharge from the rectum. 1921.—Frequent movements with blood and mucus. 1922.—Began with muco-purulent and foul-smelling discharge, and about seven weeks before seeing the reporter in April, observed pain below the sigmoidostomy opening. Two weeks later felt something fixed below the opening with some bladder discomfort, and for three weeks he had a slight temperature.

Appendectomy done in 1916, for chronic appendix, no amœba found. Lost ten pounds in four weeks. Specimen two weeks ago of the growth reported benign papilloma. Gastro-intestinal X-ray reported negative.

*Examination*, by finger, reveals a large mass in the rectum, chiefly papilloma or polyps, with a suspicious, hard portion in the base. *Diagnosis.*—Polyptosis with secondary malignancy.

April 20, 1922.—Removal of terminal sigmoid and rectum to the anus, reimplantation of the proximal opening of the sigmoidostomy. *Pathological report.*—Adenocarcinoma.

November 11, 1922.—Gained eighteen pounds—excellent condition.

April 11, 1927.—More than four and one-half years elapsed—says he has to massage his colon for a movement. Some colics, centred mid-line, began January, 1927.

*Examination.*—Mass can be felt in transverse colon. *Diagnosis.*—Secondary carcinoma. Advised resection of, but refused and wished only a colostomy in the ascending colon.

June 30, 1927.—Gained ten pounds. Can feel with finger complete stenosis of transverse colon. Advised removal of growth—again refused.

October 14, 1927.—Fine—normal weight.

July 9, 1928.—Applies for removal of growth. At same time right colos-

tomy wound presents the appearance of a carcinomaous infiltration of the skin.

July 10, 1928.—Friedrich's operation, extending well beyond the mid-portion of the transverse colon. Liberal resection of skin about the right opening.

*Pathological Analysis.*—Scirrhus carcinoma of the transverse colon. Same type in skin about the right colostomy, metastatic. Patient sent home well in four weeks. October 3, 1928: report that about the original artificial anus (left), skin appears malignant.

CASE IV.—Male, thirty-nine years old, carcinoma of the cæcum, first seen March 7, 1927. This patient stated that up to within three months, when he began to cough, he was well. Following the coughing spell he lost thirty pounds in sixty days, jaundiced for three months, no vomiting, no bleeding, appetite fair, constipated; further than this no other history could be obtained.

*Examination.*—Nothing found as to growth. *Blood.*—High state of anaemia, hæmoglobin 35 to 40 per cent., 2,800,000 plus reds. *X-Ray* by one man—cæcal deformity; by another, gastric carcinoma, by the same man a second series eliminates the stomach and calls attention to a high-placed but normal (?) cæcum.

Exploratory operation advised but refused. *Blood.*—Hæmoglobin 45 per cent., reds 3,100,000.

April 15, 1927.—Again advised exploratory. Patient disappeared until August 1, 1927, when he returned complaining of more pain in right lower quadrant, no loss and no gain in weight.

August 12, 1927.—Again X-rayed. Nothing found. *Blood.*—Hæmoglobin 76 per cent., reds 4,150,000. *Fæces.*—Slight occult blood. Again lost until October 8, 1927, when he said he had cramps quite often, four pounds loss in weight and feels weak, no blood in stool, no vomiting. Again advised operation, but refused.

January 9, 1928.—Returned and accepted operation.

An X-ray was taken and a definite deformed cæcum found.

*Operation* January 16, 1928.—Intussusception of cæcum with the ascending colon. Large eroding carcinoma of cæcum.

*Friedrich's operation done.* Diagnosis: adenocarcinoma of cæcum, chronic lymphadenitis.

May 23, 1928.—Gained thirty-five pounds.

CASE V.—Male, sixty-three years old, carcinoma of first portion of jejunum. First seen September 16, 1927. The symptomatology was indefinite, suggesting a malignancy involving the liver. His late symptoms were constant pain in the dorsal spine and right side pointing to his upper right quadrant, loss of weight, marked. Exploration advised.

*Examination.*—Plus-plus-plus tender upper right quadrant, highly nervous, urine analysis negative. *Blood.*—Secondary anaemia. Abdomen not distended. Vomiting frequently.

*Operation.*—Evident primary lesion at the ligament of Trietz in the jejunum, with metastases in the immediate vicinity and liver. Owing to the obstruction of the jejunum a jejunostomy distal to the growth was made.

CASE VI.—Male, seventy-five years old, carcinoma of the sigmoid with diverticulosis. First seen July 22, 1926, with intestinal obstruction—second attack in six months. Had seen him and his X-rays eight to ten years before. Nothing but diverticulosis at that time. Operation and all clinical evidence of inoperable carcinoma of sigmoid. Permanent sigmoidostomy made. Died October 5, 1928, seventy-seven years old. Secondaries in larynx, etc.

CASE VII.—Female, fifty-six years old, carcinoma of the hepatic flexure. First seen October 31, 1927, complaining for several years of cramps which

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always passed away without after result. Eight days preceding her visit she was seized with severe cramps, which have continued for the eight days. Eases up on passing gas, or enema. Lost fifteen pounds—is dieting also.

*Examination.*—Cæcum distended—no mass palpable. Succussion and metallic tinkle in cæcal zone on percussing from left toward the right of abdomen.

*X-ray.*—Obstruction about the hepatic flexure, demonstrated by barium colon enema.

*Operation* November 1, 1927.—First stage Mikulicz. *Pathological Diagnosis.*—Carcinoma of the hepatic colon. Patient discharged January 5, 1928.

CASE VIII.—Male, fifty-nine years old. Adenocarcinoma of rectum. *Complaint.*—Four to five years occasional bleeding and mucus, frequent desire to evacuate bowels; no pain, no loss of weight, constant sense of pressure in lower back.

*Examination.*—Mass palpable to finger. *Proctoscopic.*—Easily seen at seven and one-half inches.

*Operation.*—Mikulicz. *Pathology.*—Adenocarcinoma.

CASE IX.—Female, twenty-two years old. Rectal papilloma seventeen years. Finally rectal carcinoma. First seen March 6, 1911, bleeding from rectum, profusely at times, sense of weight, no pain, occasionally foreign body would protrude.

*Examination.*—Large papilloma, size of orange, on posterior wall about three inches up; another, size of prune, about four inches from the anal verge. Both easily excised. Apparently well for several years, then began to bleed again. Short proctoscope reveals multiple papillomata hanging from the two lower valves of Houston. Cured many times in the next eight or ten years, cauterized, etc. Numerous examinations made, always innocent until January 10, 1928, reported carcinoma, wall of vagina involved. Excision by perineal route of six inches of rectum and large section of posterior vaginal wall.

CASE X.—Female, forty-five years old, perforated carcinoma of the sigmoid with abscess. First seen September 5, 1928. *Complaint.*—Distress in left side, very tender on pressure, constipation for many months, sudden pain in left flank about eight days before seeing me, no blood, no mucus by bowel observed. No X-rays taken. Temperature 101 per rectum. Lost six pounds in ten days. Red blood cells 3,500,000, hæmoglobin 64 per cent., polymorphonuclears 74 per cent.

*Operation.*—(Dense adhesions with abscess.) Removal of sigmoid and descending colon, liberating transverse to make a side-to-side anastomosis liberal drainage. Prompt recovery in two weeks.

CASE XI.—Male, forty-three years old, carcinoma, papillary, of rectum. *Complaint.*—Bleeding from bowel three years, no protrusion on defecation, considerable pain, lost fifteen pounds in eight months, weak, constant desire to evacuate bowels. No X-rays taken.

*Examination.*—Finger: reveals a tumor the size of a small egg on posterior wall about one and one-half to three inches from the anal verge.

*Operation.*—Perineal resection. *Pathology.*—Papillary carcinoma of the rectum.

DR. HERMANN FISCHER remarked that metastasis in the liver is not regarded as a contraindication for operation, if the local condition is still operable. These metastases develop very slowly and he had seen many cases

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live after radical operation for some time in comparative comfort. He agreed with Doctor Erdmann that primary cecostomy is very important; whether a Mikulicz or a secondary resection is done, it is a vent and safety valve of great value. Third, Doctor Fischer said, he still likes to do a perineal operation for carcinoma of the rectum. Of late there has been so much enthusiasm for the combined operation for carcinoma among surgeons that they have forgotten about the Kraske operation. The speaker was not sure whether this more extensive operation has any more value for the low carcinoma in the ampula and in the sigmoid than the old Kraske; that is, if it is properly done. Doctor Fischer said he has had very good results from the Kraske operation in carcinoma of the rectum, as far as length of time of cure is concerned. In 1918 he showed fifteen cases of carcinoma of the rectum alone so operated upon with 33 per cent. of cures longer than five years. One can remove twelve to fourteen inches of the rectum easily by the perineal route.

DR. DEWITT STETTEN said that he had always been under the impression that the proper procedure in carcinoma of the colon, particularly of the recto-sigmoid junction, in the presence of liver metastases, was a conservative operation, preferably a colostomy above the growth. He was consequently very much surprised to hear Doctor Erdmann recommend radical resection under these circumstances. The speaker had recently maintained his views in such a case in which the medical man had tried to persuade him to proceed radically, because he felt it was unjustified to subject the patient to such a severe and dangerous surgical procedure with no hope of ultimate cure. The patient, in his opinion, is just as well off, as regards comfort and duration of life, with a colostomy, which would probably be required, anyway, even if the primary tumor is radically removed. He feels the situation is entirely different from that where there is an easily removable primary growth with inoperable metastases and where there is no particular risk to the operation, for instance, as in carcinoma of the breast. He believes a simple mastectomy would be entirely justifiable to remove a large ulcerating primary growth, even if there were advanced irremovable supraclavicular lymph glands or pleuro-pulmonary metastases.

He was in entire agreement with Doctor Erdmann regarding the advisability of preliminary colostomy in most cases of carcinoma of the rectum, especially where there is already some obstruction. Dr. Frederic Kammerer had always advocated this procedure as it created an opportunity for cleansing the lower loop and thus minimized the danger of infection during the radical operation, and further permitted the usual periproctitis around the tumor to subside, so that large, fixed tumors often shrunk to half the size and became freely movable within a week or two after the colostomy. In recent years Doctor Stetten believes that the Mayo Clinic has favored this procedure.

Another point in connection with this topic which Doctor Stetten would like to emphasize is that a Mikulicz "Vorlagerung" operation is by no means an entirely safe procedure. Doctor Stetten, although he has had a considerable proportion of successes, has had three unfortunate experiences with



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this operation in the past six years. In some cases, because of the position of the tumor in the lower sigmoid, because of shrinkage of the mesosigmoid, or because of metastatic involvement of the deeper mesenteric lymph glands, it is necessary to do an extensive ligation of the mesenteric vessels, usually including the inferior mesenteric artery and vein, in order to mobilize the loop sufficiently to bring it out of the abdominal cavity. The situation is frequently forced and sometimes it is absolutely impossible to control or even to gauge exactly the extent of the impairment of the viability of the gut, either of the upper or lower loop. Occasionally this extension of the gangrene is intra-abdominal in spite of every effort that can be made to prevent this occurring. Doctor Stetten's most recent case was one in which there was a definite metastatic involvement of a lymph gland at the root of the mesosigmoid and in order to get beyond this gland, it was necessary to ligate the inferior mesenteric vessels. He was quite aware of the risk he was running and made every effort to get the doubtful portion of gut well beyond the peritoneal cavity, even putting it under some tension to do so. He was not quite successful, however. The patient died within five days and a post-mortem examination showed that a small area of gangrene had developed just at the intra-abdominal margin of the upper loop.

DR. RICHARD W. BOLLING said that he had been greatly impressed with the value of the multiple stage method of resection of the colon. While its widest range of usefulness is in the left half of the colon, it may be applied to any portion of the large intestine, above the rectosigmoid. With the aid of Doctor Burford, he has recently looked over the records of the last 100 cases in which resection of the colon was done at St. Luke's Hospital. Tumors of the rectum were excluded. Of the 100 cases, in ninety-six the pathological report was carcinoma, in three lympho-sarcoma and in one, lipoma. In fifty-five cases resection was done in one stage, with immediate union of the cut ends, preceded or not by cecostomy or some other form of intestinal drainage. In this group there was an operative mortality of 26 or 47 per cent. In the remaining forty-five cases resection was accomplished in two or more stages with an operative mortality of three or slightly less than 7 per cent. Of this latter group, thirty-three were operated on after the method of Mikulicz. The contrast is striking. The multiple stage operation is, in Doctor Bolling's opinion, the method of choice in the majority of growths involving the left half of the colon. He has not had the opportunity to look up the results in the entire series. Of the nineteen cases which he operated on eight are alive; four for more than five years after operation. In fifteen of these nineteen cases resection was done in more than one stage with an operative mortality of one.

DOCTOR ERDMANN, in closing the discussion, said he was under the impression that Doctor Fischer removed the tumor as far down as possible. He had done this himself a number of times without cause for regret. In answer to Doctor Stetten he said that after one has seen a few patients in whom the growth has been left because of liver metastasis, only the establish-

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ment of an artificial anus being done, one will be impressed by the complaints burning, scalding, etc., from which death seems an escape and will be willing to take a chance with radical operation in future cases. Doctor Erdmann said he operated primarily for the patient's relief. If the growth is removed something has been accomplished if there is only temporary recovery and the patient will not be subjected to the misery of an artificial anus during the duration of life. In regard to the sloughing of the intra-abdominal portion of the sigmoid or rectum, or descending colon, if the vessel is tied so as to destroy the dichotomous distribution necrosis will occur. This is unavoidable in some subjects owing to the type of veinal distribution.

### EDITORIAL ADDRESS

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